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## The impact of massage therapy on upper extremity function in children with cerebral palsy

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### Abstract

*Introduction.* Cerebral palsy is a neurological condition that reduces motor function, leading to difficulties with upper extremity movements. Massage therapy, known for reducing muscle tension and promoting relaxation has gained attention as a rehabilitation method. However, limited research focuses on its effectiveness in children with cerebral palsy.

*Aim.* This study evaluates the impact of massage therapy on upper extremity function in children with cerebral palsy, focusing on the relationship between therapy frequency, duration and functional outcomes.

*Methodology.* A quantitative, cross-sectional design was applied, collecting data from 28 children aged 3 to 18 years through structured questionnaires. The outcomes measured included improvements in range of motion, spasticity reduction, pain relief and quality of life. Data were analyzed using ANOVA and Kruskal-Wallis H tests to assess the significance of therapy characteristics.

*Results.* Children receiving therapy 2–3 times per week for more than 12 months showed significant improvements in range of motion ( $F(2,14) = 4.91, p = 0.024$ ), spasticity reduction ( $F(3,16) = 3.44, p = 0.042$ ) and pain relief ( $F(2,14) = 7.41, p = 0.006$ ). Increased therapy frequency was also associated with better performance in daily tasks and improved quality of life ( $H(2) = 8.15, p = 0.017$ ).

*Conclusion.* Massage therapy is an effective intervention for improving upper extremity function and quality of life in children with cerebral palsy. Future research with randomized trials is recommended to validate these findings and explore long-term benefits.

**Key words:** Cerebral palsy, massage therapy, quality of life, pediatric rehabilitation, upper extremity function.

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## Introduction

Cerebral palsy is a neurological condition that affects motor control and movement, caused by abnormal brain development or injury during the prenatal, perinatal or early postnatal stages (Graham et al., 2016; Trisnowiyanto & Purwanto, 2019). This condition presents a range of challenges especially in children, including impaired motor coordination, spasticity and difficulties with fine motor skills such as grasping objects or performing daily tasks (Golubovic et al., 2014). Managing these symptoms requires a comprehensive approach involving various therapeutic methods aimed at improving motor function and quality of life (Das et al., 2019;). Among the treatments used to support children with cerebral palsy, massage therapy has gained significant attention in recent years. (Güçhan et al., 2020). Massage is known to reduce muscle tension, spasticity and improve circulation, which can lead to improved motor function, particularly in children with cerebral palsy (Mahmood et al., 2019). In cases of cerebral palsy, spasticity can severely limit upper extremity function, making even simple movements difficult to perform (Shamsoddini et al., 2014). Regular massage sessions focused on the arms and hands have been explored as a way to improve the range of motion, reduce discomfort and facilitate participation in daily activities (Bingöl et al., 2018).

In recent years, rehabilitation strategies moved beyond conventional methods to more holistic approaches and massage therapy fits in this rehabilitation methods (Gasibat et al., 2017). The growing recognition of massage therapy is because of its capacity to offer not only physical benefits but also psychological support by promoting relaxation, reducing stress and improving sense of well-being (Glew et al., 2010). For children with cerebral palsy whose physical limitations are accompanied by emotional and social challenges, the calming and positive effects of massage can serve as a complementary tool for general development (Hernandez-Reif et al., 2005).

Despite its recognized benefits, the therapeutic role of massage for children with cerebral palsy remains underexplored in clinical research, particularly regarding its long-term effectiveness (Zhang et al., 2021). Questions remain about how often massage therapy should be given, how long it needs to continue for satisfying results and what specific results can be expected (Apolo-Arenas et al., 2021). Some parents and caregivers worry about the supportability of the improvements, wondering if children will experience achievement in motor abilities or if the benefits will be short-term (Pedersen et al., 2022; Raina et al., 2005). Also, while massage can offer relief, there are time to time challenges such as discomfort from pressure or behavioral resistance from children, which need to be understood and addressed systematically (Iqra et al., 2022).

The aim of this study is to evaluate the effectiveness of massage therapy on children with cerebral palsy, specifically focusing on how it impacts upper extremities. By examining variables such as frequency, duration and participant satisfaction, this research provides insights into how massage therapy can be optimized to achieve better functional outcomes. Furthermore, the study highlights the importance of individualized therapy, as children respond differently based on the severity of their condition and their developmental stage (Katz et al., 2020).

The growing body of evidence suggests that therapeutic interventions must be both effective and sustainable, fostering improvements that expand beyond clinical settings into everyday life (Nilsson et al., 2011; Alizad et al., 2007). Massage therapy, with its dual focus on the physical and emotional well-being of the child, represents a unique rehabilitation approach that aligns with this broader goal (Williams et al., 2019; Taylor et al., 2022).

## Methodology

### *Study Design*

This research used a quantitative, cross-sectional design to investigate the impact of massage therapy on upper extremity function in children with cerebral palsy. Data were collected between 2021 and 2023 using structured questionnaires, focusing on various dimensions of therapy outcomes such as range of motion, spasticity reduction, pain relief, quality of life and therapist involvement. The design aimed to capture real-world experiences from parents or caregivers of children with cerebral palsy, emphasizing how the duration and frequency of therapy sessions influenced functional outcomes.

### *Ethical Considerations*

Participants' anonymity was fully protected by making sure that no personal or identifiable information was collected. Participation was voluntary, with implied consent through survey completion, as the act of responding indicated willingness to participate. Given the anonymous and non-invasive nature of the research, formal ethical approval was not required, and no additional ethical review was made. The research sticks to standard ethical principles for survey-based studies, including respect for privacy, confidentiality and voluntary participation without constraints.

### *Participants*

The study sample consisted of 28 children aged 3 to 18 years diagnosed with cerebral palsy and receiving massage therapy focused on the upper extremities. Participants were divided by age groups (3–5 years: 4 participants (14.3%), 6–8 years: 8 participants (28.6%), 9–12 years: 10 participants (35.7%) and 13–18 years: 6 participants (21.4%) and gender (10 males (35.7%) and 18 females (64.3%). These multiple demographics ensured the inclusion of children at different developmental stages, improving the validity of the findings.

### *Data Collection Procedure*

The questionnaire was designed to capture the duration, frequency, and effects of massage therapy on upper extremity function. Specific data points from the questionnaire included:

Duration of Therapy: Less than 3 months, 3–6 months, 6–12 months, More than 12 months.

Frequency of Therapy: Once a week, 2–3 times a week, Occasionally

Outcomes Measured: Improvements in range of motion, fine motor skills, and everyday tasks, Reduction in spasticity, pain, and discomfort, Quality of life improvements following therapy, Satisfaction levels and participants' willingness to recommend massage therapy.

This questionnaire was designed by the researchers focusing only in massage therapy effects for children with cerebral palsy. Participants also reported any adverse effects, such as hand pain due to pressure (reported by 6 participants) or skin rash due to oil use (1 participant). Additionally, 5 participants noted behavioural problems like resistance to therapy, leading to interrupted sessions.

### *Statistical Analysis*

A range of statistical methods was used to analyze the collected data. The following analyses were conducted to determine the significance of relationships between therapy characteristics and outcomes:

Descriptive Statistics: Means, medians, and standard deviations were used to summarize demographic characteristics and therapy outcomes (e.g., gender distribution, age groups, therapy frequency).

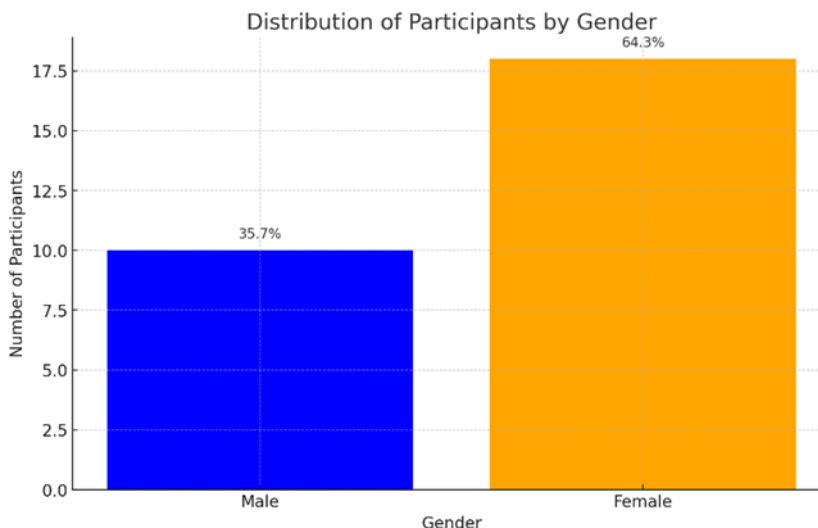
ANOVA Tests: These were used to assess the impact of therapy duration and frequency on various outcomes: Range of motion improvements:  $F(2,14) = 4.91, p = 0.024$ ; Spasticity reduction:  $F(3,16) = 3.44, p = 0.042$ ; Pain reduction:  $F(2,14) = 7.41, p = 0.006$ . These findings demonstrated significant differences, with more frequent or longer-duration therapy leading to superior outcomes.

Kruskal-Wallis H Test: The non-parametric Kruskal-Wallis test was used to assess the impact of therapy frequency on non-normally distributed outcomes: Improvement in performing everyday tasks:  $H(2) = 8.09, p = 0.018$ ; Quality of life improvements:  $H(2) = 8.15, p = 0.017$ . These tests revealed significant improvements in functional abilities and quality of life with more frequent therapy.

Qualitative Analysis of Adverse Effects: Adverse effects were reported by 11 participants, including issues such as hand pain and behavioral resistance. These qualitative findings provided valuable insights into potential challenges in maintaining consistent therapy sessions.

## Results

The study included a total of 28 participants, with 10 male participants (35.7%) and 18 female participants (64.3%). The mean number of participants per gender category is 14.00, with a standard deviation of 5.66. The higher proportion of female participants connects with the general demographic trend observed in similar studies. Figure 1 visualizes the gender distribution, with comments indicating the percentage of participants within each gender category.



**Figure 1.** Gender Analysis on Participants.

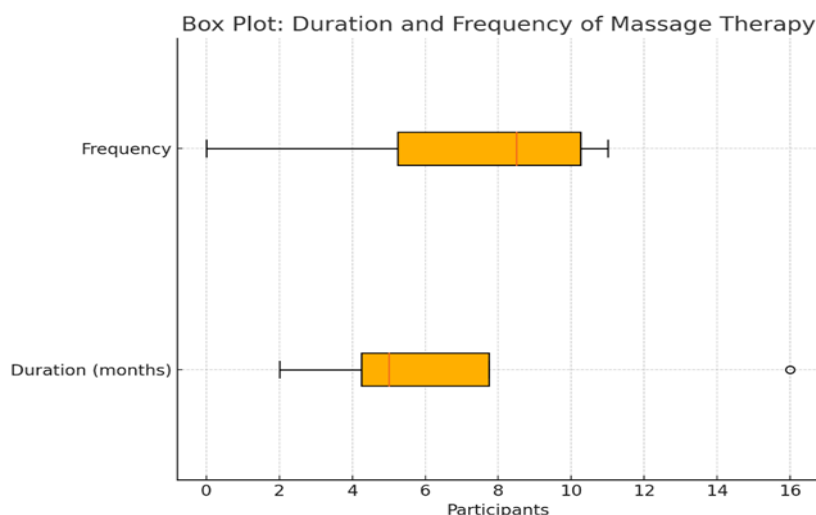
Based on Table 1, the study categorized participants into four age groups: 3–5 years, 6–8 years, 9–12 years, and 13–18 years. Out of a total of 28 participants, each age group was represented: 3 - 5 years: 4 participants (14.3%); 6 - 8 years: 8 participants (28.6%); 9 - 12 years: 10 participants (35.7%) and 13 - 18 years: 6 participants (21.4%).

**Table 1.** Age Distribution of Participants.

Age Group	Participants	Percentage (%)
3–5 years	4	14.29
6–8 years	8	28.57
9–12 years	10	35.71
13–18 years	6	21.43

The average number of participants per age group is 7.00, with a standard deviation of 2.58. The highest proportion was observed in the 9–12 years group (35.7%), followed by the 6–8 years group (28.6%). These findings suggest a relatively balanced distribution across age ranges, securing reliable information into the effectiveness of massage therapy on upper extremities among children with cerebral palsy.

Figure 2 visualizes the distributions for both duration and frequency of therapy sessions. The duration data shows a wider spread with more variability, indicating that participants are distributed across various durations. The higher quartile suggests a preference for long-term engagement, with many participants receiving therapy for more than 12 months. Outliers appear for shorter durations, such as less than 3 months. On the other hand, the frequency data reveals a narrower distribution, with most participants falling in the „once a week“ or „occasional“ categories. The absence of daily sessions focuses on a preference for less frequent, but consistent therapy sessions.



**Figure 2.** Duration and Frequency of Massage therapy

Based on Table 2, an ANOVA test was conducted to examine if the frequency of massage therapy sessions influences the improvement in range of motion of the child's arms. The results indicate a statistically significant effect,  $F(2, 14) = 4.91$ ,  $p = 0.024$ , suggesting that children who receive more frequent massage therapy tend to show greater improvements in their arm mobility. The highest mean improvement was observed in children who received therapy 2-3 times a week, while children who received therapy occasionally showed the least improvement. The statistically significant result implies that higher frequency of massage therapy is associated with better results in improving arm range of motion.

**Table 2.** ANOVA Test for Improvement in Range of Motion by Frequency of Massage Therapy

Frequency of Therapy	N	Mean Score	Std. Dev.	Min	Max
Once a week	7	4.14	0.69	3	5
2-3 times a week	5	4.60	0.55	4	5
Occasionally	5	3.40	0.55	3	4
<b>F-Statistic</b>		<b>4.91</b>			
<b>p-value</b>		<b>0.024</b>			

Based on Table 3, ANOVA test was conducted to examine whether the duration of massage therapy significantly influences the reduction in spasticity in the participants upper limbs. The results show a statistically significant effect,  $F(3, 16) = 3.44$ ,  $p = 0.042$ , indicating that longer durations of therapy are associated with better spasticity reduction results. The highest reduction in spasticity was observed in children who received therapy for more than 12 months, while the lowest reduction was reported for those who undergo therapy for less than 3 months. The results indicate that the duration of massage therapy plays a very important role in reducing spasticity, with longer durations giving better results. These findings suggest that continued therapy over an expanded period can lead to improvements in muscle relaxation and reduced spasticity in the upper limbs.

**Table 3.** ANOVA Test for Reduction in Spasticity by Duration of Massage Therapy

Duration of Therapy	N	Mean Score	Std. Dev.	Min	Max
Less than 3 months	2	3.50	0.71	3	4
3-6 months	5	4.00	0.71	3	5
6-12 months	5	4.60	0.55	4	5
More than 12 months	8	4.88	0.35	4	5
<b>F-Statistic</b>		<b>3.44</b>			
<b>p-value</b>		<b>0.042</b>			

According to Table 4, the last ANOVA test was conducted to assess whether the frequency of massage therapy sessions in a great matter influences the reduction in pain and discomfort in the child's upper extremities. The results indicate a statistically significant difference,  $F(2, 14) = 7.41, p = 0.006$ , suggesting that the frequency of therapy plays a meaningful role in reducing pain and discomfort. The highest reduction in pain was observed in children receiving therapy 2-3 times a week, while those receiving therapy occasionally reported the least reduction in discomfort. The frequency of massage therapy sessions has a statistically significant impact on pain reduction, with more frequent sessions resulting in greater pain relief. These findings focus on the importance of regular therapy sessions for achieving optimal pain management in children.

**Table 4.** ANOVA Test for Reduction in Pain and Discomfort by Frequency of Massage Therapy

Frequency of Therapy	N	Mean Score	Std. Dev.	Min	Max
Once a week	7	4.14	0.69	3	5
2-3 times a week	5	4.60	0.55	4	5
Occasionally	5	3.20	0.45	3	4
<b>F-Statistic</b>		<b>7.41</b>			
<b>p-value</b>		<b>0.006</b>			

According to Table 5, a Kruskal-Wallis H test was conducted to assess if the frequency of massage therapy sessions influences the improvement in the participants ability to perform everyday tasks (e.g., grasping, holding objects). The p-value (0.018) indicated that the result is statistically significant. This suggests that the frequency of therapy sessions plays a crucial role in the child's improvement in performing everyday tasks. The highest improvement was observed in children receiving therapy 2-3 times a week, while those receiving therapy occasionally showed the least improvement. These findings accent the importance of frequent therapy sessions for improving functional abilities.

**Table 5.** Kruskal-Wallis H Test for Improvement in Everyday Tasks by Frequency of Massage Therapy

Frequency of Therapy	N	Median Score	Min	Max
Once a week	7	4.00	3	5
2-3 times a week	5	5.00	4	5
Occasionally	5	3.00	3	4
<b>Test Statistic (H)</b>		<b>8.09</b>		
<b>p-value</b>		<b>0.018</b>		

Also, from Table 6 we conducted a Kruskal-Wallis H test to explore the impact of frequency of massage therapy sessions on the child's quality of life improvements. The results revealed a statistically significant difference in quality-of-life scores across different therapy frequencies,  $H(2) = 8.15, p = 0.017$ . This indicates that the frequency of therapy plays a crucial role in improving the child's general well-being. The highest improvements were reported among children who received therapy 2-3 times a week (Median = 5.00), followed closely by those attending once a week (Median = 4.00).

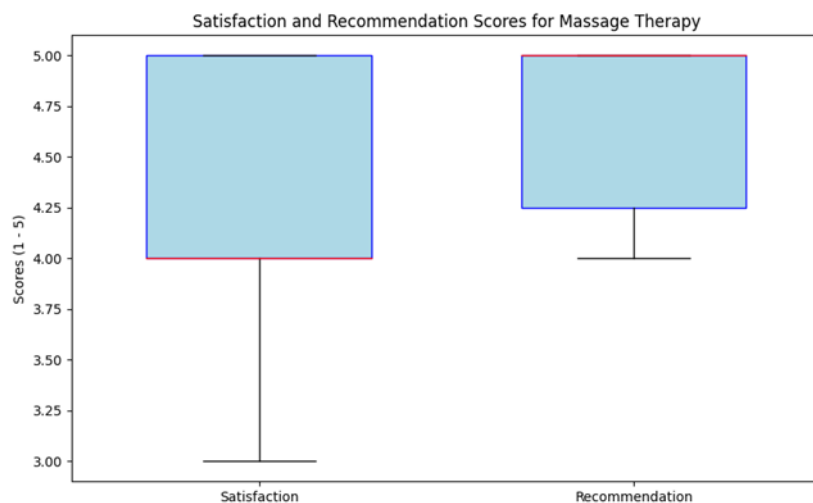
**Table 6.** Kruskal-Wallis H Test for Quality-of-Life Improvement by Frequency of Therapy

Frequency of Therapy	N	Median Score	Min	Max
Once a week	7	4.00	3	5
2-3 times a week	5	5.00	4	5
Occasionally	5	3.00	3	4
<b>Test Statistic (H)</b>		<b>8.15</b>		
<b>p-value</b>		<b>0.017</b>		

In contrast, children who received therapy only occasionally exhibited the lowest improvements (Median = 3.00). This suggests a clear trend where more frequent sessions gave better quality of life outcomes. The results

demonstrate that higher therapy frequency is associated with higher quality of life improvements. These findings support the recommendation of 2-3 sessions per week as an effective intervention strategy to maximize the therapeutic benefits of massage therapy for children with motor impairments.

Figure 3 shows that both satisfaction and recommendation scores are high, with a slightly higher median score for recommendation. The satisfaction scores display more variability (higher standard deviation), suggesting that individual experiences may differ more in satisfaction with the therapy results. However, the recommendation scores are consistently high, indicating that participants support the use of massage therapy for other children with cerebral palsy. Both distributions suggest that the participants are generally satisfied with the outcomes and are likely to recommend the therapy. The high scores strengthen the positive impact of massage therapy on children's well-being and functional improvements.



**Figure 3.** Satisfaction and Recommendation Scores for Massage therapy

## Interpretation and Limitations

The study findings strongly suggest that more frequent massage therapy sessions (2–3 times per week) and longer period of time (over 12 months) are associated with significantly better outcomes. These outcomes include improvements in range of motion, reduction in spasticity, and pain relief, as well as enhancements in the child's ability to perform daily tasks and overall quality of life. The frequency of therapy sessions showed a statistically significant impact on functional improvements, underscoring the importance of sustained and regular intervention for children with cerebral palsy.

Despite these promising results, the study has several important limitations that must be considered. First, the small sample size of 28 participants limits the generalizability of the findings. A larger and more diverse sample would be necessary to confidently apply these results to a wider population of children with cerebral palsy, especially those with varying levels of impairment or other complicating factors. Second, the study lacks a control group, which limits the ability to establish a causal relationship between the massage therapy and the observed improvements. Without a control group for comparison, it is difficult to rule out the influence of external factors or natural progression in the condition over time.

Another limitation is the reliance on caregiver-reported outcomes, which may introduce a degree of subjectivity. Although the caregivers are intimately familiar with the children's conditions, their perceptions of improvement may be influenced by personal biases or expectations regarding the therapy's effectiveness. Future studies would benefit from incorporating objective measures of motor function and quality of life, such as standardized clinical assessments or biomechanical evaluations.

Lastly, the study did not account for potential confounding variables, such as concurrent therapies (e.g., physical or occupational therapy) that participants may have been undergoing. The effects of these additional

therapies may have contributed to the observed improvements, making it difficult to isolate the impact of massage therapy alone.

## Discussion

This study provides crucial insights into the therapeutic potential of massage therapy in children with cerebral palsy. The findings indicate that both frequency and duration of massage therapy influence functional results in children with cerebral palsy, particularly in terms of improving range of motion, reducing spasticity, pain and improving the ability to perform everyday tasks. Specifically, the data suggest that children receiving massage therapy 2–3 times a week for over 12 months showed the most substantial improvements in motor abilities and overall quality of life.

In addition to physical improvements, the study highlights the psychological benefits of massage therapy, such as relaxation and emotional well-being. These effects are critical for children facing both physical impairments and social challenges. However, challenges were noted, including behavioral resistance from some children and minor adverse effects, such as discomfort from pressure or skin irritation caused by the oils used during therapy. These findings underscore the need for individualized treatment plans that take into account both physical and psychological factors to ensure sustainable outcomes.

The study by Xiaosu Jie et al. (2019) accents the positive impact of combining modern rehabilitation methods with acupuncture and massage therapy on children with cerebral palsy, achieving a 90% effectiveness rate compared to 78% in the control group. Additionally, the incidence of sequelae was significantly lower (14%) in the intervention group. This draws attention to integrated approaches, including massage that are effective in improving motor function and reducing complications. Comparatively, our study focused solely on massage and its frequency, revealing that 2-3 sessions per week provided optimal results for spasticity reduction and functional improvements. While Xiaosu Jie et al.'s research suggests that combining massage with other therapies may produce even better outcomes, both studies confirm the important role of massage in rehabilitation, supporting its use as a valuable intervention for children with cerebral palsy.

Chen et al. (2021) demonstrates that combining meridian acupuncture with massage improves motor development in children with spastic cerebral palsy. Their study shows superior results in motor ability, daily activities and reductions in muscle tension compared to routine rehabilitation. Additionally, the combination therapy reduced inflammatory markers such as IL-6 and TNF- $\alpha$ , further supporting the therapeutic benefits. When compared to our results, both studies focus on the effectiveness of massage in improving motor function. However, Chen et al.'s research goes a step further by integrating acupuncture, resulting in wider improvements in motor skills, daily activities and inflammation management. While our study focuses on massage alone, showing improvements in spasticity reduction, range of motion and quality of life, Chen et al.'s findings suggest that combining therapies could provide even more comprehensive benefits. Both studies affirm the potential of non-invasive therapies for children with cerebral palsy.

Another study focuses on how massage therapy, combined with social reinforcement improves both physical and psychological well-being in children with cerebral palsy. The intervention demonstrated improvements in motor control, relaxation and emotional engagement, with the added benefit of strengthening social bonds and communication between the patient and caregivers. When compared to our research, both studies focus on the positive impact of massage therapy in improving motor function. While our study focuses more specifically on upper extremity improvements and spasticity reduction, this research focus on broader psychological benefits, showing that massage therapy not only improves physical health but also improves emotional well-being. Both studies affirm the holistic value of massage therapy as an effective rehabilitation strategy for children with cerebral palsy (Suresh et al., 2022).

Muazarroh et al. (2022) conducted a meta-analysis evaluating the effectiveness of massage therapy in reducing spasticity in children with cerebral palsy, using the Modified Ashworth Scale (MAS) to measure outcomes. The analysis of nine RCTs demonstrated that massage therapy reduces spasticity in both upper and lower extremities, confirming its value as an effective intervention. Compared to our research, both studies focus on the effectiveness of massage in managing spasticity. However, our study focuses on upper extremity function and



improvements in motor ability, while Muazarroh et al. provide a broader view, including both upper and lower extremities.

## Conclusion

This study focuses on the therapeutic potential of massage therapy for improving upper extremity function in children with cerebral palsy. The findings confirm that both the frequency and duration of therapy play crucial roles in improving motor abilities, reducing spasticity, reducing the pain and improving the ability to perform everyday tasks. Also, this study found out that children receiving massage therapy 2-3 times per week over extended periods (more than 12 months) showed the most significant improvements in range of motion, motor coordination and quality of life.

This research also draws attention to the psychological benefits of massage therapy, including emotional well-being, relaxation and stress reduction, which are particularly relevant for children with physical and social challenges. However, the study also identifies challenges, such as occasional behavioral resistance from participants and minor adverse effects (e.g., discomfort from pressure, skin irritation), focusing on the need for individualized treatment plans.

This study builds on existing literature by providing focused information about the impact of massage therapy on the upper extremities. While previous researches focused on the value of integrated rehabilitation approaches, this study isolates the effects of massage therapy alone, proving it to be an effective intervention. However, limitations such as the small sample size and lack of a control group necessitate further investigation. Future research should use randomized controlled trials to establish causal relationships and explore the long-term sustainability of the observed benefits.

Generally, this research strengthens the importance of regular and customized massage therapy sessions as a practical and non-invasive rehabilitation strategy for children with cerebral palsy. The findings support the recommendation of scheduling massage therapy 2-3 times per week to achieve optimal functional outcomes and improve quality of life, preparing future studies to build upon these promising results.

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