

# COMPARING THE EFFECTIVENESS OF SENSORY INTEGRATION THERAPY AND FINE MOTOR THERAPY ON ENHANCING FINE MOTOR SKILLS IN CHILDREN WITH AUTISM SPECTRUM DISORDER: A RANDOMIZED CONTROLLED TRIAL

*Original Research*

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## ABSTRACT

**Background:** Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition characterized by impairments in communication, social interaction, and motor function. Fine motor delays are frequently observed in children with ASD and can significantly interfere with self-care, academic tasks, and daily independence. Sensory Integration Therapy (SIT) has emerged as a complementary approach within occupational therapy to address sensory processing issues linked with motor difficulties. Despite its increasing use, there remains limited comparative research assessing the added value of SIT when combined with conventional Fine Motor Therapy (FMT).

**Objective:** To compare the effectiveness of Fine Motor Therapy alone versus Sensory Integration Therapy combined with Fine Motor Therapy in enhancing fine motor skills among children diagnosed with Autism Spectrum Disorder.

**Methods:** A randomized controlled trial was conducted with 42 children aged 3 to 6 years, diagnosed with ASD based on DSM-5 criteria. Participants were selected through systematic probability sampling and randomly assigned to either an experimental group (SIT+FMT, n = 21) or a control group (FMT only, n = 21). Both groups received three therapy sessions per week for eight consecutive weeks. Interventions were administered individually by trained occupational therapists. Fine motor outcomes were assessed pre- and post-intervention using the Fine Motor Skills Checklist. Data analysis was performed using SPSS version 27, with statistical significance set at  $p < 0.05$ .

**Results:** Post-intervention, the experimental group showed a 20% improvement in mean fine motor scores (from 138.4 to 165.7), whereas the control group improved by 10% (from 140.2 to 148.3). Statistically significant improvements were observed in tasks such as gripping, cutting, buttoning, and name writing among children in the SIT+FMT group ( $p < 0.05$ ).

**Conclusion:** Integrating Sensory Integration Therapy with Fine Motor Therapy significantly enhances fine motor outcomes in children with ASD compared to motor therapy alone. These findings advocate for incorporating sensory-based strategies into pediatric occupational therapy protocols to better support functional development.

**Keywords:** Autism Spectrum Disorder, Fine Motor Skills, Fine Motor Therapy, Occupational Therapy, Pediatric Rehabilitation, Sensory Integration Therapy, Sensory Processing.

## INTRODUCTION

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition marked by impairments in social interaction and communication, often accompanied by restrictive and repetitive behaviors. Affecting approximately 1% of the pediatric population, ASD is notably more prevalent in males than females (1). The presentation of ASD is highly variable, ranging from individuals with profound developmental delays to those with high-functioning autism, who possess average or above-average intellectual abilities and may function independently in various aspects of life. Amidst this clinical heterogeneity, one common and often overlooked concern among children with ASD is the delay or dysfunction in motor skill development, particularly fine motor skills. These impairments, often noticeable by six months of age, tend to become more pronounced as children grow, affecting essential tasks such as handwriting, buttoning clothes, drawing, and using tools—skills that are fundamental for academic performance and daily independence (2,3). Fine motor skills require the integration of cognitive processing, visual-motor coordination, and manual dexterity, all of which may be compromised in children with ASD. Research indicates that these children frequently face challenges in visual-perceptual abilities and motor planning, limiting their engagement in age-appropriate functional tasks and impacting both educational attainment and social interaction (4). Consequently, there is an increasing emphasis on early and targeted therapeutic interventions to address these motor difficulties, thereby enhancing the quality of life and learning experiences of affected individuals (5).

Occupational therapy approaches for ASD have increasingly incorporated sensory-based techniques to support sensory processing and motor coordination. Among these, Sensory Integration Therapy (SIT) has emerged as a widely adopted modality. SIT is grounded in the premise that difficulties in processing sensory information underlie many functional impairments in children with ASD. By delivering structured vestibular, proprioceptive, tactile, and auditory stimuli, SIT aims to enhance neural integration and improve the child's ability to respond adaptively to environmental demands (6). In parallel, Fine Motor Therapy (FMT) remains a cornerstone intervention, focusing on specific, task-oriented exercises to strengthen hand function and improve coordination. Despite the established use of both SIT and FMT independently, the potential benefits of a combined therapeutic approach remain underexplored. Preliminary studies suggest that SIT may confer added advantages in sensory regulation and motor control. For instance, a study demonstrated that, SIT produced greater gains in fine motor performance compared to FMT alone (7,8). Similarly, research indicated notable improvements in motor function and occupational performance following SIT interventions in children with ASD (9,10). However, existing literature lacks robust comparative analyses evaluating whether the integration of SIT with FMT yields superior outcomes over FMT alone. Given the critical importance of fine motor competence for a child's academic and social development, and the gaps in current research, further investigation into integrative therapeutic strategies is warranted (11). The present study seeks to address this gap by comparing the effectiveness of Sensory Integration Therapy combined with Fine Motor Therapy (SIT+FMT) versus Fine Motor Therapy alone in improving fine motor skills in children diagnosed with ASD. It is rationalized that children receiving the combined intervention will demonstrate significantly greater improvements in fine motor abilities, thereby supporting a more holistic and effective therapeutic model.

## METHODS

A randomized controlled trial was conducted to investigate the comparative effectiveness of Sensory Integration Therapy (SIT) combined with Fine Motor Therapy (FMT) versus FMT alone in enhancing fine motor skills among children diagnosed with Autism Spectrum Disorder (ASD). A total of 42 children between the ages of 3 and 6 years, who had been formally diagnosed with ASD based on DSM-5 criteria by a qualified developmental pediatrician or pediatric neurologist, were enrolled in the study. Participants were selected through systematic sampling from a larger clinical population and then randomly allocated into two equal groups: the experimental group (SIT+FMT;  $n=21$ ) and the control group (FMT only;  $n=21$ ). Inclusion criteria required children to fall within the defined age range, demonstrate mild to moderate ASD symptom severity, and exhibit no significant cognitive impairment or physical disability that would interfere with motor skill assessment. Children receiving concurrent therapies targeting fine motor or sensory skills, or those with severe uncorrected visual or hearing impairments, were excluded from the study to preserve the internal validity of the results (10,12).

The intervention spanned eight weeks and was delivered by certified occupational therapists in a standardized clinical environment. Children in both groups received therapy three times per week, with each session lasting 45 minutes. The control group received structured Fine Motor Therapy involving activities designed to enhance bilateral coordination, grip strength, hand-eye coordination, and visual-motor integration. The experimental group received the same FMT protocol supplemented with Sensory Integration Therapy, which involved targeted tactile, proprioceptive, vestibular, and auditory input intended to enhance sensory modulation and integration. All sessions followed consistent therapeutic protocols to ensure treatment fidelity across participants. To assess changes in motor and sensory performance, two validated instruments were utilized: the Short Sensory Profile (SSP) and the Fine Motor Skills Checklist. These were administered at baseline and following completion of the 8-week intervention. Assessments were carried out by trained evaluators blinded to group allocation to minimize observer bias. The version of the Fine Motor Skills Checklist used was standardized for pediatric occupational therapy and included age-appropriate milestones relevant to the 3–6-year age group.

Data were analyzed using SPSS version 27. Descriptive statistics summarized demographic variables including age and gender distribution across groups. Paired sample t-tests were applied to examine within-group differences between pre- and post-intervention scores for fine motor function. Pearson correlation analysis was further employed to explore the relationship between sensory processing scores and fine motor abilities. A significance level of  $p < 0.05$  was adopted for all inferential statistical tests. Ethical clearance for the study was obtained from the Institutional Review Board. Prior to data collection, written informed consent was obtained from the legal guardians of all participating children after explaining the purpose, procedures, benefits, and potential risks of the study.

## RESULTS

Among the 42 participating children diagnosed with Autism Spectrum Disorder, 28.6% demonstrated typical sensory performance based on the Short Sensory Profile, while 33.3% exhibited probable sensory differences, and 38.1% showed definite sensory processing difficulties. These results highlight that over 70% of the children had either probable or definite sensory integration issues. In terms of age distribution, both the experimental and control groups were relatively balanced. In the control group, 19.0% of the children were 3 years old, 23.8% were aged 4, 33.3% were 5 years old, and 23.8% were aged 6. The experimental group similarly included 23.8% of children aged 3, 33.3% aged 4, 23.8% aged 5, and 19.0% aged 6. A comparative correlation analysis of fine motor skill development in relation to sensory input was conducted across both groups. At age 3, the ability to cut a piece of paper in half showed a strong positive correlation with sensory input ( $r = 0.913$ ,  $p = 0.030$ ), whereas no meaningful association was found in the absence of sensory intervention ( $r = 0.174$ ,  $p = 0.826$ ). Skills such as cutting along a wide line (1/2" accuracy) showed no significant correlation in either condition. For children aged 4, notable improvements were observed with sensory input. Cutting along a line with a deviation of 1/8 to 1/4 inch had a significant correlation under sensory intervention ( $r = 0.891$ ,  $p = 0.017$ ), while the same task without sensory input showed a non-significant association ( $r = 0.667$ ,  $p = 0.219$ ). Using a fork correctly yielded a very strong correlation with sensory input ( $r = 0.926$ ,  $p = 0.008$ ), in contrast to a lower and non-significant correlation without it ( $r = 0.700$ ,  $p = 0.188$ ). Other age-appropriate tasks, such as getting dressed and undressed independently ( $r = 0.857$ ,  $p = 0.029$ ), also displayed meaningful improvements with sensory support. At age 5, printing one's name demonstrated a strong association in both groups, but the effect was more pronounced with sensory input ( $r = 0.919$ ,  $p = 0.028$ ). The ability to copy a triangle shape revealed perfect correlation in the sensory condition ( $r = 1.000$ ,  $p = 0.000$ ) and a strong correlation in the absence of sensory input ( $r = 0.914$ ,  $p = 0.011$ ). Interestingly, drawing a diamond shape when given a model showed a negative correlation with sensory input ( $r = -0.559$ ,  $p = 0.327$ ) and a strong positive correlation without it ( $r = 0.914$ ,  $p = 0.011$ ), suggesting task-specific variability in the effect of sensory therapy. In the 6-year-old cohort, the ability to write three or more simple words was perfectly correlated with sensory therapy ( $r = 1.000$ ,  $p = 0.000$ ), and moderately associated without it ( $r = 0.800$ ,  $p = 0.104$ ). The task of copying one's first name showed moderate associations in both conditions, but the printing of numbers 0–9 did not demonstrate any significant relationship in either group, indicating that not all fine motor activities benefited uniformly from sensory input.

To quantify the therapeutic impact of the interventions, mean fine motor skill scores were compared before and after the 8-week therapy period in both groups. In the experimental group receiving combined Sensory Integration Therapy and Fine Motor Therapy (SIT+FMT), the pre-intervention mean score was 138.4, which significantly improved to 165.7 post-intervention, reflecting a mean improvement of 27.3 points. In contrast, the control group receiving only Fine Motor Therapy (FMT) demonstrated a more modest improvement, with a mean score increase from 140.2 to 148.3, accounting for a mean gain of 8.1 points. These results suggest a substantially greater enhancement in fine motor skills among children who received the combined SIT+FMT approach compared to those who received FMT alone, aligning with the study's hypothesis that integrated sensory input significantly augments motor learning in children with ASD.

**Table 1: Sensory Issues in Children**

	Frequency	Percent
Typical Performance (190-155)	12	28.6
Probable Difference (154-142)	14	33.3
Definite Difference (141-38)	16	38.1
Total	42	100.0

**Table 2: Ages of control group**

	Frequency	Percent
3 Years	4	19.0
4 Years	5	23.8
5 Years	7	33.3
6 Years	5	23.8
Total	21	100.0

**Table 3: Ages of children in Experimental group**

	Frequency	Percent
3 Years	5	23.8
4 Years	7	33.3
5 Years	5	23.8
6 Years	4	19.0
Total	21	100.0

**Table 4: Comparison between Control group and Experimental group**

Skill	Age Group	r(With Sensory)	P(With Sensory)	r(Without Sensory)	p(Without Sensory)
Cuts a piece of paper in half	Age 3	0.913	0.030	0.174	0.826
Can cut along a wide line (1/2" accuracy)	Age 3	0.250	0.685	0.000	1.000
Can copy cross shapes, right and left oblique lines	Age 4	0.243	0.643	0.000	1.000
Can touch the tip of each finger to their thumb	Age 4	0.408	0.422	0.250	0.685
Will fasten and unfasten large buttons	Age 4	0.581	0.226	0.559	0.327
Cuts along a line (1/8-1/4" deviation)	Age 4	0.891	0.017	0.667	0.219
Can cut big circles with scissors	Age 4	0.632	0.178	0.559	0.327
Can move the paper while cutting along a line	Age 4	0.297	0.568	0.896	0.039
Completes puzzles of 4-5 pieces	Age 4	0.293	0.573	1.000	0.000
Can use a fork correctly	Age 4	0.926	0.008	0.700	0.188
Can get dressed and undressed without help	Age 4	0.857	0.029	0.750	0.125
Begins to print their name	Age 5	0.919	0.028	0.800	0.104
Copies a triangle shape	Age 5	1.000	0.000	0.914	0.011
Can tie their shoes	Age 5	0.450	0.370	0.857	0.029
Draw a diamond shape when given a model	Age 5	-0.559	0.327	0.914	0.011
Can copy first name	Age 6	0.577	0.423	0.400	0.600
Prints 3 or more simple words	Age 6	1.000	0.000	0.800	0.104
Can print all numbers 0-9	Age 6	0.000	1.000	0.083	0.876

**Table 5: Pre and Post Intervention Mean Comparison**

Group	Pre-Intervention Mean Score	Post-Intervention Mean Score	Mean Improvement
Experimental (SIT+FMT)	138.4	165.7	27.299
Control (FMT only)	140.2	148.3	8.100

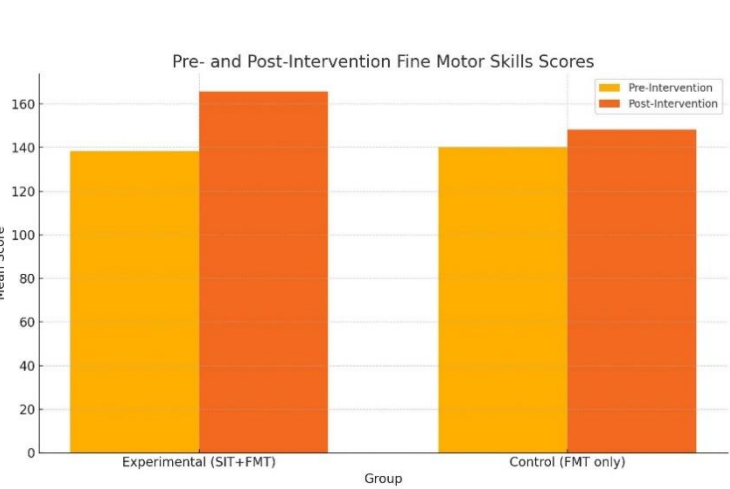


Figure 1 Pre- and Post-Intervention Fine Motor Skills Scores

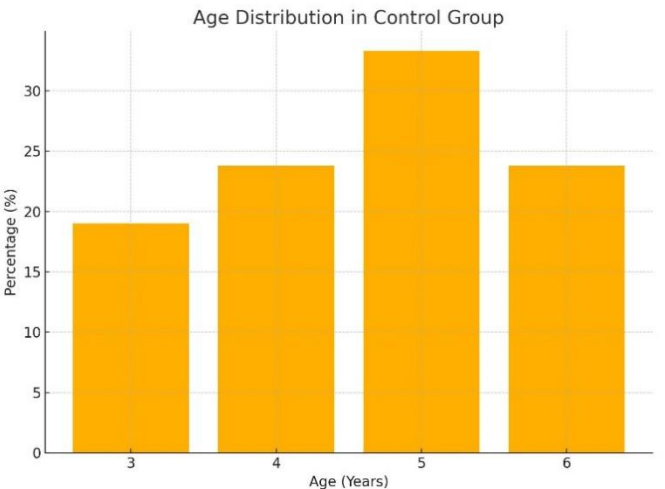


Figure 2 Age Distribution in Control Group

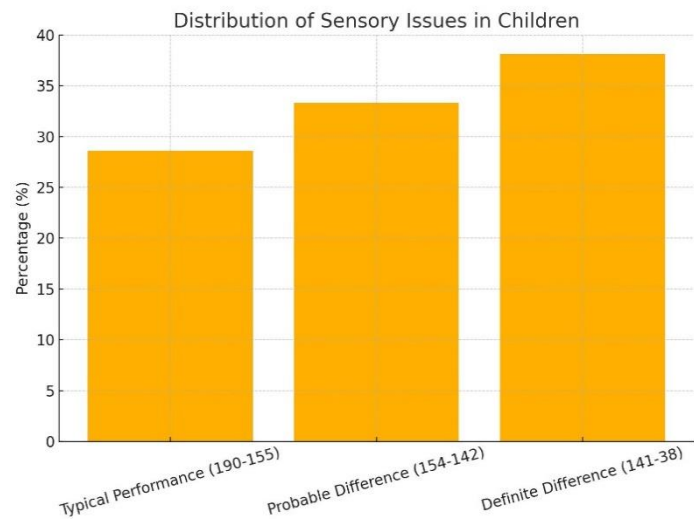


Figure 1 Distribution of Sensory Issues in Children

**DISCUSSION**

The findings of the present study underscore the therapeutic value of combining Sensory Integration Therapy (SIT) with Fine Motor Therapy (FMT) in enhancing fine motor skills among children diagnosed with Autism Spectrum Disorder (ASD). The experimental group, which received the integrated intervention, exhibited significantly greater improvements in motor function compared to the group receiving FMT alone. These outcomes suggest that augmenting motor-based therapies with sensory integration strategies can produce more comprehensive and effective results in addressing motor deficits associated with ASD (13). This enhanced outcome aligns with earlier reports in the literature, which highlighted improvements in hand-eye coordination, object manipulation, and overall motor planning following sensory-focused interventions. These improvements may be attributed to better sensory modulation, allowing



children to interpret and respond more accurately to tactile, proprioceptive, and vestibular inputs (14,15). In turn, this facilitates smoother execution of fine motor tasks such as using utensils, fastening buttons, and forming letters. Studies employing similar individualized therapy protocols have reported comparable improvements in children's ability to perform functionally relevant activities, reinforcing the value of personalized interventions (16). Nonetheless, findings from other research have been more conservative, showing limited gains in fine motor outcomes following SIT. Such discrepancies may reflect differences in therapeutic delivery models, including group-based versus individualized settings, variation in session frequency, or inconsistency in intervention fidelity. In this study, therapy was provided through one-on-one sessions conducted by trained occupational therapists, ensuring that each child received tailored sensory and motor challenges aligned with their individual needs, potentially accounting for the stronger outcomes observed (17,18).

The methodological strengths of this study include its randomized controlled design, standardized assessment tools, and controlled delivery of interventions in a clinical setting. Moreover, the inclusion of age-stratified comparisons and correlation analyses added depth to the findings, providing insights into task-specific responses to sensory input (19). Despite these strengths, certain limitations must be acknowledged. The sample size was modest, limiting the statistical power and generalizability of the results. Additionally, the intervention period of eight weeks may not have been sufficient to capture the full extent of potential developmental changes, particularly for complex and higher-order motor skills. Another limitation involves the absence of long-term follow-up, which restricts conclusions about the durability of treatment effects. It remains unclear whether the observed improvements would be maintained over time or translate into broader functional gains across other domains such as academic achievement or social participation. Furthermore, while the study demonstrated statistically significant changes in motor function, qualitative outcomes such as caregiver satisfaction and child engagement were not explored but could offer valuable perspectives in future investigations.

Future research should consider larger, multicenter trials with extended intervention durations and follow-up periods to assess long-term effectiveness. Including additional outcome domains such as behavioral regulation, social communication, and adaptive functioning would provide a more holistic understanding of the intervention's impact. Moreover, integrating caregiver-reported measures and observational tools could enrich the clinical relevance of findings and support the development of more family-centered care models (20). Overall, the present study provides promising evidence supporting the combined use of SIT and FMT for improving fine motor skills in children with ASD. These findings contribute to a growing body of literature advocating for integrative, individualized therapeutic strategies that target the complex sensory and motor challenges faced by this population.

## CONCLUSION

This study concludes that integrating Sensory Integration Therapy with Fine Motor Therapy offers meaningful benefits for children with autism spectrum disorder, particularly in enhancing fine motor coordination, task performance, and self-care abilities. The combined approach proved more effective than motor therapy alone, underscoring the importance of addressing sensory processing alongside motor development. These findings highlight the practical value of incorporating individualized, sensory-based interventions within pediatric rehabilitation programs to support more comprehensive and functional outcomes. Tailoring therapies to the unique sensory profiles of each child remains essential for optimizing engagement and long-term skill acquisition.

## AUTHOR CONTRIBUTION

Author	Contribution
Tayyaba Khan*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
M. Naveed Babur	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Areesha Shahbaz	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Ambreen Sadaf	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Areej Asmat	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

Author	Contribution
Esha Rana	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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