

## Structured Sensory Motor Rehabilitation And Its Impact On Postural Stability And Cognitive Attention In Children With Down Syndrome

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### ABSTRACT

The main aim of the current study was to determine the effects of Structured Sensory Motor Rehabilitation (SSMR) on the postural stability and cognitive attention of children with Down syndrome. Using a pre- and post-test control group design, this study was conducted using an experimental research strategy. We recruited 150 children with Down syndrome and split them evenly between an experimental group and a control group for the trial. In contrast to the control group, who received more traditional treatment sessions, the experimental group took part in an organised SSMR program. The children's levels of functional engagement, motor coordination, postural stability, and cognitive attention were measured using established testing procedures. Compared to the control group, the experimental group shown substantial improvement, which is a very encouraging finding from the study. In terms of postural stability, the experimental group outperformed the control group by 90.1%. When compared to the control group, those in the experimental group showed a 110.4% improvement in cognitive attention. Results showed a 1% improvement in the control group. The functional outcomes also showed improvement in attention span, balance and coordination, muscle control, motor planning as well as social participation.

**Keywords:** Down Syndrome, Structured Sensory Motor Rehabilitation, Postural Stability, Cognitive Attention, Motor Coordination, Balance Training, Functional Participation, Pediatric Rehabilitation.

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### 1. INTRODUCTION

Down syndrome is among the commonly known types of genetic problems afflicting children around the world (Ben Hassen et al., 2023). The condition results in mental retardation, delayed development in terms of physical activities, low muscle tone, and poor balance and coordination (Borji et al., 2023). Children with this condition tend to have problems maintaining body balance as well as sustaining their cognitive attention (Brugnaro et al., 2022). This poses limitations in their performance at school, social life, and other areas. Therefore, there is a need to devise appropriate intervention strategies to improve the lives of such children (Büyükcelik et al., 2023).

The Structured Sensory Motor Rehabilitation is believed to be a key method in helping patients acquire skills related to sensory integration, coordination, balance, and attention (Moriello et al., 2020). During the sensory motor rehabilitation, certain sensory motor exercises are performed systematically which stimulate the vestibular, proprioceptive, and tactile systems, thus contributing to neuromuscular and cognitive improvement (Pena et al., 2019). The practice of

sensory motor activities will result in developing such skills as good posture, motor planning, and attention (Raghupathy et al., 2022). The current study is aimed at the examination of the effect of the implementation of Structured Sensory Motor Rehabilitation on postural stability and attention among the Down Syndrome patients (Torres-Carrión et al., 2019). The main objectives of the study include finding out whether the introduction of a certain systematic rehabilitation approach can bring positive changes in the mentioned parameters in comparison to existing methods (Valencia-Jimenez et al., 2023). The results obtained in the course of the research may be used for creating more efficient rehabilitation techniques for improving patients' lives (Vandoni et al., 2023).

### 2. LITERATURE REVIEW

Adeeb N et al. (2021) performed a systematic review to evaluate the currently available therapies employed to enhance the ability to maintain balance in patients with Down syndrome. The review highlighted the use of several types of rehabilitation techniques such as balance exercises, sensory integration therapy, and

motor coordination exercises. The results indicated that systematic physical rehabilitation therapies were found effective in improving postural control, balance skills, and motor abilities of children with Down syndrome (Adeeb et al., 2021). **Al-Nemr A. and Reffat S. (2024)** investigated the effect of Pilates on the improvement of gross motor coordination and balance in Down syndrome children. This goal was achieved by the implementation of a structured physical training program that included exercises designed to improve mobility, stability, and coordination (Al-Nemr & Reffat, 2024). The study's findings demonstrated that the kids made great strides in enhancing their motor coordination and balance.

**Baberwal M et al. (2025)** performed a quasi-experimental study to examine how sensory integration treatment affected the motor skills and attention span of Down syndrome children. It was found that children receiving sensory integration therapy had improved attention and coordination skills along with increased involvement in tasks (Baberwal et al., 2025). The conclusion drawn by the researchers was that sensory-based therapies were crucial for the development of these children.

### 3. RESEARCH METHODOLOGY

The research methodology provides an overview of the scientific methods used in examining the efficacy of the Structured Sensory Motor Rehabilitation in improving postural stability and cognitive attention among Down syndrome-afflicted children. This includes the research design, the sampling technique, the data gathering process, and the statistical techniques employed in analyzing the data gathered from the experiment.

#### 3.1 Research Design

The current research employed the experimental methodological approach in evaluating the efficacy of Structured Sensory-Motor Rehabilitation (SSMR) for improving postural balance and cognitive attention among children with Down syndrome. The methodology involved the application of pre-test and post-test designs on two groups of subjects.

#### 3.2 Study Population and Sample Size

The sample for this study comprised children with Down syndrome undergoing treatment and education programs at selected rehabilitation centers. The study sample consisted of 150 participants. The sample was divided into two equal groups, as follows:

- Experimental Group – 75 participants
- Control Group – 75 participants

#### 3.3 Sampling Technique and Selection Criteria

A purposive sampling method was used to recruit subjects using pre-determined inclusion criteria. The study sample comprised children ages 6 to 11 years who were healthy enough to engage in rehabilitation exercises. Those with significant neurological, musculoskeletal, visual, or auditory impairment were not considered for this study.

#### 3.4 Data Collection Tools and Procedure

The collection of data was done through standardized assessment tools for measuring postural stability, attention, motor skills, and participation in activities. The pre-test measures were taken prior to the administration of the intervention, while the post-test measures were taken after the completion of the rehabilitation intervention.

#### 3.5 Statistical Analysis

The data was analysed using descriptive and inferential statistics. The experimental and control groups' pre- and post-test scores were compared using the following statistical methods: mean, standard deviation (SD), percentage improvement, paired t-test, and independent t-test. When testing for statistical significance, a p-value of less than 0.05 was deemed significant at the 95% confidence level.

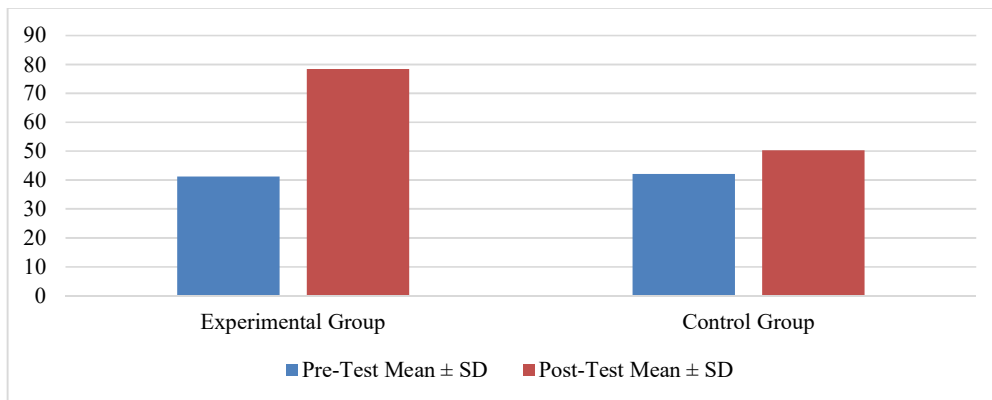
### 4. RESULT

Tables 1 and Figure 1 show the post-intervention mean scores of the experimental and control groups regarding their postural stability. The analysis of the results showed whether Structured Sensory Motor Rehabilitation helped improve the balance abilities of children with Down syndrome. The experimental group underwent rehabilitation treatment; however, the control group used only conventional treatment.

**Table 1.** Comparison of Mean Postural Stability Scores Before and After Intervention

Groups	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference	t-value	p-value	Improvement (%)
Experimental Group	41.26 ± 3.15	78.45 ± 4.22	37.19	5.82	0.001	90.1%
Control Group	42.11 ± 3.42	50.38 ± 3.95	8.27	1.94	0.082	19.6%

Structured Sensory Motor Rehabilitation And Its Impact On Postural Stability And Cognitive Attention In Children With Down Syndrome



**Figure 1:** Graphical Representation of Comparison of Mean Postural Stability Scores Before and After Intervention

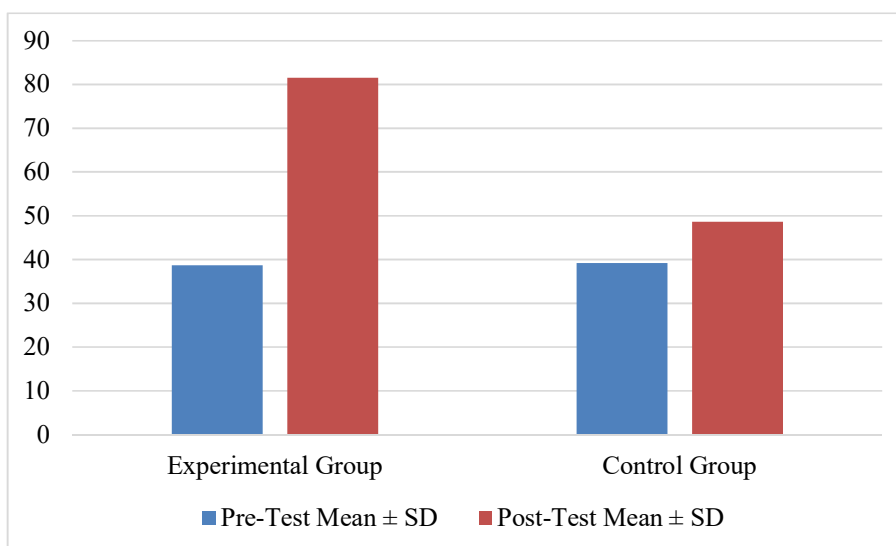
The results show that the experimental group significantly improved their postural stability. With a difference of 37.19 points and an improvement of 90.1%, the mean value increased from 41.26 points before the test to 78.45 points after the test. The control group, on the other hand, improved their postural stability by 19.6%, with a mean value rise from 42.11 to 50.38 (with a standard deviation of 8.27). The control group did not show a statistically significant increase in postural stability ( $p = 0.082$ ), in contrast to the

experimental group which showed a statistically significant improvement ( $p = 0.001$ ).

Tables 2 and Figure 2 demonstrate the analysis of the mean cognitive attention scores of the experimental and control groups both before and after the experiment. It is necessary to note that the examination was carried out to test whether there were significant changes in the level of cognitive attention and concentration in children suffering from Down's syndrome as a result of Structured Sensory Motor Rehabilitation.

**Table 2.** Comparison of Mean Cognitive Attention Scores Before and After Intervention

Groups	Pre-Test Mean ± SD	Post-Test Mean ± SD	Mean Difference	t-value	p-value	Improvement (%)
Experimental Group	38.74 ± 2.98	81.52 ± 4.35	42.78	6.15	0.001	110.4%
Control Group	39.18 ± 3.11	48.63 ± 3.76	9.45	2.02	0.067	24.1%



**Figure 2:** Graphical Representation of Comparison of Mean Cognitive Attention Scores Before and After Intervention

The results show that the experimental group members' cognitive attention abilities significantly improved following the trial. With a mean difference of 42.78 and a total percentage gain of 110.4%, cognitive attention abilities improved from an average of 38.74 in the pre-

test to an average of 81.52 in the post-test. In contrast, the control group showed only a modest rate of progress, going from an average pre-test score of 39.18 to a post-test score of 48.63 (a 9.45-point difference and a 24.1% increase, respectively). Children with Down syndrome

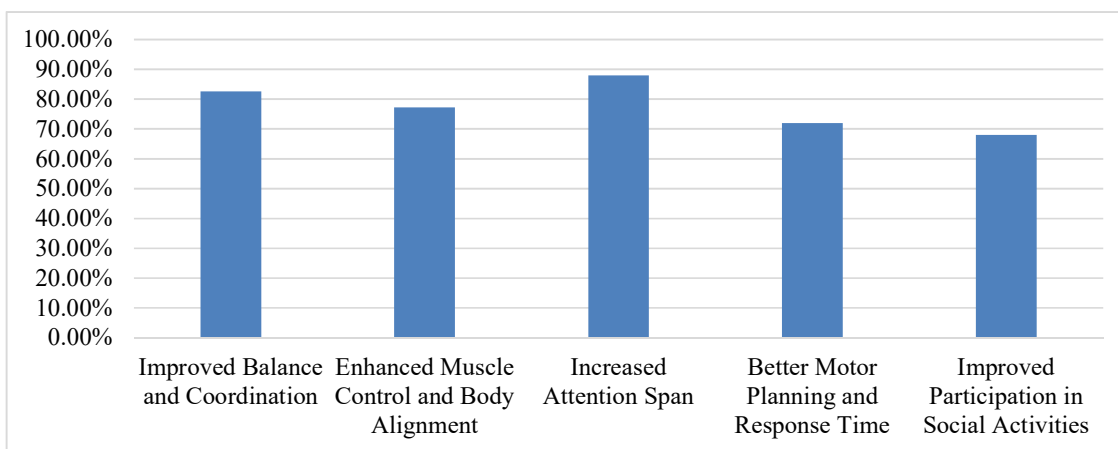
Structured Sensory Motor Rehabilitation And Its Impact On Postural Stability And Cognitive Attention In Children With Down Syndrome

who participated in Structured Sensory Motor Rehabilitation showed a statistically significant improvement in their cognitive attention levels ( $p = 0.001$ ). There was no statistically significant improvement in the control group ( $p = 0.067$ ). Table 3 and Figure 3 show the functional gains made by the children with Down syndrome who underwent

SSMSR therapy. This includes information about the number of subjects and the percentage of participants who improved on specific functional parameters such as coordination, muscle control, concentration, motor planning, and social interaction.

**Table 3.** Functional Improvement Achieved After Structured Sensory Motor Rehabilitation

Functional Outcome Measures	Number of Improved Participants	Percentage (%)	p-value
Improved Balance and Coordination	62	82.7%	0.001
Enhanced Muscle Control and Body Alignment	58	77.3%	0.001
Increased Attention Span	66	88.0%	0.001
Better Motor Planning and Response Time	54	72.0%	0.001
Improved Participation in Social Activities	51	68.0%	0.001



**Figure 3:** Graphical Representation of Functional Improvement Achieved After Structured Sensory Motor Rehabilitation

The results show a great improvement in function for the subjects after participating in the rehabilitation program. The greatest improvement is seen in the area of increased attention span, where there was an improvement in 66 individuals (88.0%). Improvements in balance and coordination have been reported by 62 individuals (82.7%), while improvements in muscle control and posture have been reported by 58 individuals (77.3%). Motor planning and reaction time improvements were seen in 54 individuals (72.0%), and improvement in social engagement was seen in 51 individuals (68.0%). Statistical analysis revealed that the functional improvements observed among the participants in the experimental group were statistically significant ( $p = 0.001$ ), indicating the effectiveness of

Structured Sensory Motor Rehabilitation in improving balance, attention span, muscle control, motor planning, and social participation among children with Down syndrome. It can be concluded that SSMR has greatly helped in improving function in children with Down syndrome.

Table 4 and Figure 4 display the aggregate findings of the comparison analysis between the control group and the experimental group. To determine if Structured Sensory-Motor Rehabilitation was effective for children with Down syndrome, researchers compared it to other programs and looked at outcomes in areas including postural stability, attention, motor coordination, and functional engagement.

**Table 4.** Overall Comparative Outcome Between Experimental and Control Groups

Outcome Variables	Experimental Group Improved (%)	Control Group Improved (%)	p-value
Postural Stability	65.3%	25.3%	0.001
Cognitive Attention	62.7%	22.7%	0.001
Motor Coordination	77.3%	30.7%	0.001
Functional Participation	68.0%	29.3%	0.001

Structured Sensory Motor Rehabilitation And Its Impact On Postural Stability And Cognitive Attention In Children With Down Syndrome

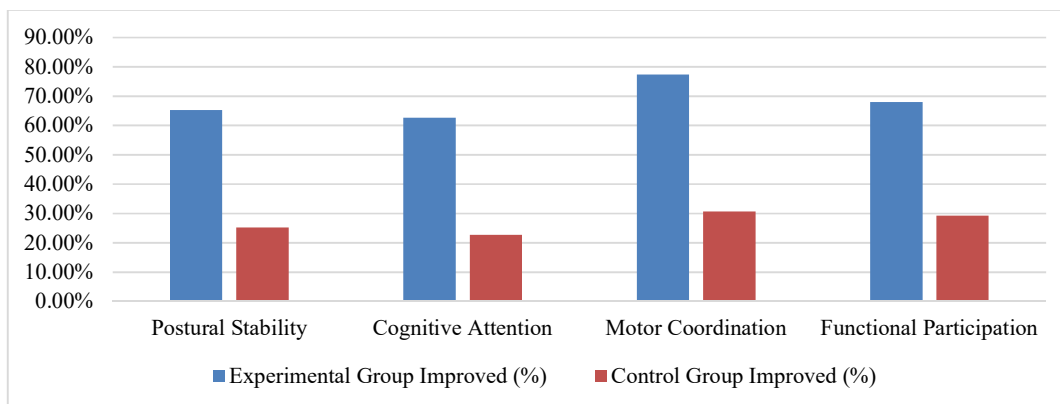


Figure 4: Graphical Representation of Overall Comparative Outcome Between Experimental and Control Groups

The results show that the experimental group had significantly higher percentages of improvement on each of the outcome variables than the control group. The highest improvement was found in the motor coordination category (77.3%; Experimental) and in functional participation (68.0%), whereas postural stability (65.3%) and cognitive attention (62.7%) had the lowest improvements. The percentages of improvement for the control group in comparison were relatively small in all domains. The experimental group exhibited statistically significant differences favoring itself when compared to the control group ( $p = 0.001$ ). The findings confirm that Structured Sensory Motor Rehabilitation produced superior improvements in postural stability, cognitive attention, motor coordination, and functional participation among children with Down syndrome. The results suggest that Structured Sensory Motor Rehabilitation was effective for improving children's physical function, attentional skills and participation in the lives of children with Down syndrome.

### 5. DISCUSSION

The results of the present study revealed the significant positive effect of Structured Sensory Motor Rehabilitation (SSMR) on postural stability and cognitive attention of children with Down syndrome. Experimental group demonstrated significant enhancement in their attentional performance, coordination, and balance functions as compared to the control group. There was a significant improvement in postural stability scores following intervention, suggesting structured sensory motor activities had a significant effect on improvement in neuromuscular control and body balance (Yana et al., 2024). Likewise, cognitive attention scores also significantly increased, indicating better concentration, focus and response functions in the participants that completed the rehabilitation training.

In addition, the study revealed significant gains in motor coordination, attention span, muscle control and functional participation in the experimental group. The increase in all outcome variables, across all groups, is seen as evidence of the effectiveness of the Structured Sensory Motor Rehabilitation in improving physical

and cognitive outcomes in children with Down syndrome (Zago et al., 2020). The study thus reinforces the need for incorporating sensory motor rehabilitation programs into therapeutic interventions for functional independence and quality of life for this population.

### 6. CONCLUSION

The current study found that Structured Sensory Motor Rehabilitation (SSMR) is extremely effective in providing postural stability and cognitive attention to children with DS. Results showed that there was a considerable improvement in balance, coordination, attentional focus, motor planning, muscle control, and functional participation for the participants who received the rehab program compared to the control group. The large percentage changes seen in postural stability and attention to cognitive tasks suggest that structured sensory motor activities have a positive impact on both physical and cognitive functioning in children with down syndrome. The study also highlights the need to include sensory motor rehabilitation techniques in the therapeutic treatment of children with DS in order to achieve increased functional independence, more participation in daily activities and better quality of life.

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