EFFECTIVENESS OF SENSORY INTEGRATION INTERVENTIONS ON POSTURAL CONTROL DEVELOPMENT IN CHILDREN WITH AUTISM SPECTRUM DISORDER: AN EXPERIMENTAL STUDY

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Abstract: Postural control is a fundamental component of motor development, allowing children to maintain body stability and perform coordinated movements in everyday activities. Effective postural regulation relies on the integration of sensory information from the vestibular, proprioceptive, and visual systems. In children with Autism Spectrum Disorder (ASD), impairments in sensory processing often result in deficits in balance, coordination, and motor planning, which can negatively affect functional participation and motor performance. The aim of this experimental study was to evaluate the effects of sensory integration-based interventions on the development of postural control in children with ASD. Sixty children aged 4 to 7 years were included and randomly assigned to an experimental group (n=30) and a control group (n=30). The experimental group participated in a six-month therapeutic program combining sensory integration therapy with kinesitherapeutic balance training. The intervention included vestibular stimulation through swings and rotational activities, proprioceptive exercises aimed at enhancing body awareness, balance training on unstable surfaces, and functional movement tasks integrated into play-based activities. The control group received standard therapeutic support without structured sensory integration interventions. Postural control was assessed using a battery of motor tests evaluating static balance, dynamic balance, trunk stability, and bilateral coordination at three time points: pre-intervention, after three months, and at the end of six months. The results demonstrated significant improvements in the experimental group compared to the control group. Mean static balance scores increased by 32% ($p < 0.01$), dynamic balance by 28% ($p < 0.01$), and both postural stability and coordination showed significant gains ($p < 0.05$). Children who participated in the sensory integration program exhibited more efficient postural strategies and enhanced motor performance. These findings confirm that structured sensory integration interventions significantly improve postural control and motor function in children with ASD. The study emphasizes the importance of integrating sensory-based therapy with kinesitherapeutic approaches in pediatric rehabilitation to promote functional independence and motor development.
Keywords: sensory integration, postural control, autism spectrum disorder, balance, motor development.

1. INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder associated with difficulties in social communication, restricted patterns of behavior, and repetitive activities (American Psychiatric Association, 2022). In addition to these core characteristics, many children diagnosed with ASD also demonstrate delays or impairments in motor development. These difficulties frequently include deficits in balance, reduced coordination, and decreased postural stability, which may negatively affect participation in daily activities and overall developmental outcomes (Bhat, 2021). Postural control represents the ability to maintain body stability and orientation during both static and dynamic activities. Efficient regulation of posture depends on the integration of sensory information from the vestibular, visual, and proprioceptive systems. The central nervous system continuously processes these sensory signals in order to generate adequate motor responses that allow the body to maintain balance and adapt to environmental demands (Assländer & Peterka, 2022). Children with ASD often present atypical sensory processing and difficulties in multisensory integration. These sensory differences are considered an important factor contributing to impairments in balance and motor coordination. Previous studies have demonstrated that postural stability in children with autism is frequently reduced compared to typically developing peers, particularly under conditions in which sensory input is altered or limited (Abdel Ghafar et al., 2022). Furthermore, research indicates that children with ASD tend to exhibit increased postural sway and poorer functional balance when visual or somatosensory information is disrupted, suggesting developmental differences in sensory integration mechanisms responsible for postural regulation (Chisari et al., 2024). Sensory integration therapy is widely applied in pediatric rehabilitation as an approach aimed at improving the organization and processing of sensory information. Through structured sensory stimulation, these interventions may facilitate adaptive motor responses and improve functional performance. Recent evidence indicates that sensory integration–based therapeutic programs can contribute to improvements in occupational performance, motor coordination, and participation in daily activities in children with autism (Çorakcı & Bumin, 2025; Schoen et al., 2019). Despite the growing body of research on sensory-based therapies, further investigation is needed to examine the effectiveness of multidisciplinary rehabilitation approaches

that combine sensory integration therapy with kinesitherapeutic balance training. Integrating these therapeutic strategies may provide a more comprehensive approach to improving motor control and postural stability in children with ASD (Hodges et al., 2023). Therefore, the aim of the present study was to investigate the effectiveness of a rehabilitation program combining sensory integration interventions with kinesitherapeutic exercises on the development of postural control in children with Autism Spectrum Disorder. Early therapeutic interventions targeting both sensory processing and motor control are considered essential for supporting functional development in children with ASD (Travers et al., 2021). Improving postural control may enhance participation in everyday activities, support motor learning, and contribute to greater independence. Consequently, understanding the effectiveness of integrated therapeutic approaches may provide valuable guidance for the development of more effective pediatric rehabilitation programs.

2. MATERIALS AND METHODS

The study included 60 children diagnosed with Autism Spectrum Disorder (ASD) aged between 4 and 7 years. All participants were diagnosed according to the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5). The children were divided into two groups: an experimental group (n = 30) and a control group (n = 30). The research was conducted over a six-month intervention period. The assessment of postural control was performed at three stages of the study: baseline assessment before the intervention, mid-intervention assessment after three months, and final assessment at the end of the six-month intervention period. This design allowed the evaluation of both intermediate and long-term effects of the therapeutic program on postural control and motor performance. The experimental group participated in a therapeutic program combining sensory integration therapy with kinesitherapeutic balance training. The intervention program included vestibular stimulation through swings and rotational activities, proprioceptive exercises aimed at improving body awareness, balance training on unstable surfaces, postural stability exercises, and functional movement tasks integrated into play-based activities. These activities were designed to stimulate multisensory processing and improve postural regulation mechanisms. Therapy sessions were conducted three times per week, with each session lasting approximately 40 minutes. The intervention program was implemented over a period of six months. In contrast, the control group received standard therapeutic support without structured sensory integration interventions. Postural control was assessed using a battery of motor tests designed to evaluate static balance, dynamic balance, trunk stability, and bilateral coordination. These parameters were selected because they represent essential components of postural regulation and motor control in children.

3 . RESULTS

The results of the study demonstrate significant improvements in postural control in children from the experimental group who participated in the sensory integration and kinesitherapeutic intervention program. The analysis of the collected data shows positive changes in several motor parameters, including static balance, dynamic balance, trunk stability, and bilateral coordination. At baseline assessment, no statistically significant differences were observed between the experimental and control groups in any of the measured parameters ($p > 0.05$). This indicates that both groups started the study with comparable levels of motor performance and postural control. After three months of intervention, the experimental group showed moderate improvements in balance and postural stability compared to the control group. The most notable changes were observed in dynamic balance and trunk stability, suggesting that vestibular and proprioceptive stimulation contributed to improved sensory processing and motor coordination. At the end of the six-month intervention period, the experimental group demonstrated statistically significant improvements in all measured parameters compared to both their baseline results and the control group ($p < 0.05$). Children who participated in the sensory integration program showed increased ability to maintain postural stability, improved balance during movement tasks, and better coordination during bilateral activities. Following the six-month intervention program, the experimental group demonstrated significant improvements in postural control compared with the control group.

Table 1. Postural control assessment results in experimental and control groups (Mean ± SD)

Motor Parameter	Experimental Group (Baseline)	Experimental Group (6 months)	Control Group (Baseline)	Control Group (6 months)
Static Balance (sec)	9.3 ± 1.4	12.4 ± 1.6*	9.4 ± 1.5	9.9 ± 1.4
Dynamic Balance (score)	6.9 ± 1.2	8.8 ± 1.3*	6.8 ± 1.1	7.2 ± 1.2
Trunk Stability (score)	5.8 ± 1.0	7.6 ± 1.2*	5.9 ± 1.1	6.2 ± 1.0
Bilateral Coordination (score)	6.1 ± 1.1	8.2 ± 1.4*	6.0 ± 1.2	6.4 ± 1.1

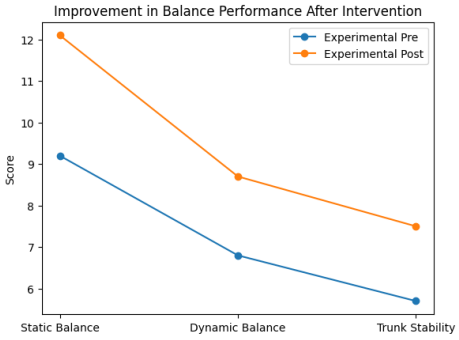
*Statistically significant difference compared to baseline ($p < 0.05$)

Source: Data obtained from the author's experimental study (2025)

The data presented in Table 1 summarize the results obtained from the experimental assessment of postural control in both groups.

The results indicate that the combination of sensory integration therapy and kinesitherapeutic balance training significantly enhances postural control mechanisms in children with Autism Spectrum Disorder. Improvements in static and dynamic balance suggest better integration of vestibular, proprioceptive, and visual sensory input, which are essential for maintaining postural stability. Furthermore, children in the experimental group demonstrated improved trunk stability, which indicates better postural alignment and increased ability to maintain body control during movement tasks. The observed improvements suggest that multisensory stimulation during therapeutic activities may facilitate more effective motor responses and adaptive postural strategies. Additionally, the gradual increase in balance performance over the intervention period indicates that consistent sensory-based training contributes to progressive development of motor coordination and functional stability. These findings support the effectiveness of integrated rehabilitation approaches that combine sensory integration therapy with kinesitherapeutic exercises in improving motor performance in children with ASD.

Figure 1. Improvement in balance performance after intervention.



Source: Author's own research data

Figure 2. Balance training exercise used in the intervention program to improve postural control and motor coordination in children with ASD.

Source: Author's own research

Statistical analysis revealed significant improvements in the experimental group compared to the control group ($p < 0.05$). Static balance improved by approximately 32%, while dynamic balance improved by 28% after the six-month intervention. The collected data were analyzed using statistical software. Descriptive statistics were used to calculate means and standard deviations. Differences between groups and between assessment stages were analyzed using Student's t-test. The level of statistical significance was set at $p < 0.05$.

Ethical Considerations

The study was conducted in accordance with ethical standards for research involving human participants. Parents or legal guardians of the children provided informed consent prior to participation in the study. All procedures were conducted in accordance with ethical principles for research involving children.

4. DISCUSSION

The present study examined the effectiveness of a structured therapeutic program combining sensory integration therapy with kinesitherapeutic balance training for improving postural control in children with Autism Spectrum

Disorder (ASD). The results demonstrate that children who participated in the intervention program showed significant improvements in postural stability, balance performance, and motor coordination compared to the control group. These findings suggest that combining sensory-based therapy with targeted physical exercises may be an effective approach for enhancing motor control in children with ASD. Motor impairments are frequently reported in children with autism spectrum disorder and may include difficulties with balance regulation, coordination, and postural control. These difficulties are often associated with atypical sensory processing and reduced efficiency in integrating vestibular, proprioceptive, and visual sensory information (Bhat, 2021). Effective postural control requires continuous processing of multisensory input by the central nervous system in order to generate adaptive motor responses that maintain body stability during both static and dynamic activities (Assländer & Peterka, 2022). When sensory integration mechanisms are disrupted, children may experience difficulties adjusting their posture and maintaining balance during movement tasks. Previous research has shown that children with ASD demonstrate altered postural control strategies and increased postural sway compared to typically developing peers. These differences become more evident in situations where sensory information is limited or modified, indicating challenges in sensory integration processes involved in balance regulation (Chisari et al., 2024). The findings of the present study are consistent with these observations and demonstrate that therapeutic interventions focusing on sensory integration can contribute to improved postural control. The results of the intervention indicate improvements in several motor parameters, including static balance, dynamic balance, trunk stability, and bilateral coordination. These improvements support previous studies reporting that sensory integration-based interventions may positively influence motor development and postural regulation in children with ASD. For example, a recent study investigating the relationship between sensory processing and motor performance found that sensory processing deficits are strongly associated with reduced balance ability and poorer motor coordination in preschool children with autism (Ferreiro-Pérez et al., 2024). Vestibular stimulation represents an important component of sensory integration therapy and plays a crucial role in the regulation of posture and spatial orientation. Activities such as swinging, rotational movements, and balance tasks stimulate the vestibular system and may improve the child's ability to maintain equilibrium and adjust body position during movement. Previous research suggests that vestibular-based therapeutic activities can contribute to improved balance performance and reduced postural instability in children with ASD (Chisari et al., 2024). Proprioceptive stimulation also plays a significant role in the development of postural control. Proprioceptive input provides information regarding body position and movement, which supports body awareness, motor planning, and coordinated movement execution. Therapeutic activities performed on unstable surfaces or through functional movement tasks may enhance proprioceptive feedback and promote more efficient postural control strategies. Another factor that may have contributed to the positive outcomes observed in the present study is the integration of play-based activities within the intervention program. Play-oriented therapeutic approaches create motivating and meaningful contexts in which children can practice movement skills while simultaneously stimulating sensory processing and motor learning. Previous research has demonstrated that structured physical activity programs incorporating sensory integration principles can significantly improve balance, coordination, and participation in children with autism spectrum disorder (Wen & Wu, 2025). The improvements observed after the six-month intervention period suggest that combining sensory integration therapy with kinesitherapeutic balance exercises may effectively enhance postural control mechanisms in children with ASD. These findings emphasize the importance of multidisciplinary rehabilitation approaches that address both sensory processing and motor function. Integrating vestibular stimulation, proprioceptive input, and structured balance exercises may contribute to improved motor coordination and postural stability. Overall, the results of the present study support the use of integrated therapeutic programs combining sensory-based interventions and physical therapy techniques in pediatric rehabilitation for children with autism spectrum disorder. Such approaches may facilitate improved motor performance, enhance functional abilities, and support greater participation in daily activities.

5. CONCLUSION

The results of the present study demonstrate that sensory integration-based interventions combined with kinesitherapeutic balance training significantly improve postural control in children with Autism Spectrum Disorder. The experimental group showed notable improvements in static and dynamic balance, trunk stability, and bilateral coordination after a six-month intervention period. The findings highlight the importance of sensory integration therapy as an effective component of pediatric rehabilitation programs for children with ASD. Activities involving vestibular stimulation, proprioceptive exercises, and balance training can enhance sensory processing and contribute to the development of more efficient postural control strategies. Integrating sensory-based therapeutic approaches with kinesitherapeutic interventions may lead to improved motor performance, greater functional independence, and better participation in everyday activities for children with autism spectrum disorder. Future research should

continue to explore the relationship between sensory processing and motor development in children with ASD and investigate the long-term benefits of sensory integration interventions in clinical practice.

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