Journal of Clinical and Nursing Research, 2026, Volume 10, Issue 1
http://ojs.bbwpublisher.com/index.php/JCNR
Online ISSN: 2208-3693
Print ISSN: 2208-3685

Research on the Rehabilitation Treatment Effect of Sensory Integration Training Combined with Cognitive Training in Children with Mental Retardation

Chunhui Song, Ying Tian

The 82nd Group Army Hospital of the Chinese People's Liberation Army, Baoding 071000, Hebei, China

Abstract: *Objective*: To analyze the clinical effect of sensory integration training combined with cognitive training in the rehabilitation treatment of children with mental retardation. *Methods*: A total of 120 children with mental retardation who received rehabilitation intervention in our hospital from January 2022 to December 2025 were selected and divided into a control group and an experimental group, with 60 children in each group. The control group adopted a conventional rehabilitation training program; the experimental group adopted a combined sensory integration training and cognitive training program. The sensory integration ability, cognitive function, and daily living skills of children in the two groups were compared. *Results:* The sensory integration ability score of the experimental group (85.3 ± 6.2) was significantly higher than that of the control group (72.1 ± 7.5) ($p < 0.05$); the cognitive function score (88.7 ± 5.8) was significantly improved compared with that of the control group (76.4 ± 6.9) ($p < 0.05$); the daily living skills score (90.2 ± 4.7) was significantly higher than that of the control group (80.5 ± 5.3) ($p < 0.05$). The social interaction ability of the experimental group reached 92.5%, which was significantly higher than that of the control group (81.3%) ($p < 0.05$). *Conclusion:* Sensory integration training combined with cognitive training demonstrates favorable outcomes in the rehabilitation treatment of children with mental retardation, exhibiting a notable neurofunctional remodeling effect. It can optimize the multidimensional rehabilitation process, effectively enhance the comprehensive developmental potential of children, and hold significant clinical application value.

Keywords: Sensory integration training; Cognitive training; Mental retardation

Online publication: Feb 10, 2026

1. Introduction

Mental retardation is a relatively common neurodevelopmental disorder in children, primarily characterized by significantly lower intellectual functioning than the average level. In severe cases, it may be accompanied by language expression disorders, difficulties in motor coordination, and a lack of social interaction, which seriously affect children's cognitive development and learning ability enhancement. Excessive stimulation can even trigger emotional and behavioral disorders, with long-term impacts on social adaptability, leading to symptoms such as inattention, impulsive behavior, and emotional instability in affected children. Clinical manifestations include delayed language development, fine motor disorders, and social avoidance. In clinical treatment, traditional rehabilitation methods mainly focus on single sensory stimulation or basic cognitive exercises, which are limited by their constrained intervention dimensions, insufficient sustained effectiveness, and low individualized adaptability. These methods have limited potential in promoting neural plasticity in affected children, potentially leading to stagnation in the rehabilitation process, hindering functional improvement, and increasing the psychological burden on families. Undeniably, traditional therapy plays a certain role in maintaining basic functions and its practical value cannot be overlooked. Therefore, it is necessary to explore more efficient comprehensive intervention strategies. Against this backdrop, sensory integration training combined with cognitive training has gradually become a research hotspot. This therapeutic approach offers the advantage of multi-system integration and, compared to the unidirectional stimulation model of traditional therapy, its advantages are more pronounced, as it can simultaneously improve sensory processing and cognitive executive functions [1].

2. Materials and methods

2.1. Clinical data

A total of 120 children with intellectual developmental retardation who visited the Pediatric Rehabilitation Department of our hospital from January 2022 to December 2025 were selected, including 72 males and 48 females. They were randomly divided into a control group and an experimental group, with 60 children in each group. The age range of children in the control group was 3–10 years, with an average age of 6.8 years, while that of the experimental group was 3–10 years, with an average age of 6.5 years.

2.1.1. Inclusion criteria

(1) Age between 3 and 10 years;

(2) Meeting the GESELL diagnostic criteria for intellectual developmental retardation;

(3) Parents provided signed informed consent.

2.1.2. Exclusion criteria

(1) Severe physical comorbidities that prevented cooperation with training;

(2) Severe visual or hearing impairments affecting assessment;

(3) Comorbid autism spectrum disorder requiring differential intervention.

2.1.3. Grouping

There were no statistically significant differences between the two groups in baseline characteristics such as gender distribution, age composition, and baseline developmental level ($p > 0.05$), confirming comparability between the groups.

2.2. Methods

2.2.1. Control group

Children in the control group received conventional rehabilitation training. Dosage and usage: Once daily for 60 minutes per session. During training, it is essential to avoid excessive fatigue and ensure environmental safety precautions. Adjustments to the training plan should be made promptly if emotional breakdowns or physical discomfort occur. Continuous training was conducted for 12 weeks. If persistent attention distraction was observed, training was immediately paused, and emotional comfort interventions were implemented to address behavioral issues. Training intensity was continuously adjusted based on a predefined plan, with task difficulty modified according to the child's immediate responses and functional progress. Heart rate and emotional states were closely monitored, and positive reinforcement strategies were actively applied to children with anxiety tendencies to maintain training compliance goals. Targeted limb coordination exercises were provided for children with certain motor coordination disorders [2].

2.2.2. Experimental group

Children in the experimental group received a combined sensory integration training and cognitive training program. Dosage and usage for sensory integration training: Once daily for 40 minutes per session, with attention to controlling environmental sensory load during training [3]. Dosage and usage for cognitive training: Once daily for 20 minutes per session, with emphasis on a stepwise task design. Continuous training was conducted for 12 weeks. During training, a multimodal feedback system was integrated, and attention was paid to the dynamic changes in the children's sensory thresholds. If a child exhibited signs of sensory overload, the intensity of stimuli was reduced, and guidance on sensory regulation strategies was provided to ensure a smooth progression of the child's neural adaptation process [4].

2.3. Observation indicators

The sensory integration abilities of children in the two groups were assessed using the GESELL Developmental Schedules (which covers social skills, gross motor, language, fine motor, and adaptive behaviors). The scores range from 0 to 100, with higher scores indicating better function [5]. Cognitive function was evaluated using the Childhood Autism Rating Scale (CARS), scored from 15 to 60, where lower scores indicate better function. Daily living abilities were assessed with the Activities of Daily Living (ADL) scale, scored from 0 to 100, with higher scores indicating better function. Social interaction was measured using the Social Skills Checklist (SSC), scored from 0 to 50, with higher scores indicating better function [6].

2.4. Statistical analysis

The data were analyzed using SPSS 26.0 statistical software. Continuous data were described using mean ± standard deviation ($\overline{x} \pm s$), with independent sample *t*-tests for between-group comparisons and paired *t*-tests for within-group comparisons. Categorical data were expressed as frequencies and percentages, with chi-square (χ^2) tests for between-group comparisons. A p-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of sensory integration abilities between the two groups

The study revealed that the vestibular balance function score of the experimental group was (85.3 ± 6.2), significantly superior to that of the control group (72.1 ± 7.5), with a statistically significant difference ($p < 0.05$). The tactile defensive response score, reflecting sensory processing efficiency, was (82.7 ± 5.8) in the experimental group, compared to (70.4 ± 6.9) in the control group, with a statistically significant difference ($p < 0.05$). See **Table 1**.

Table 1. Comparison of sensory integration abilities between two groups of children

Group	n	Social skills	Gross motor	Language	Fine motor	Adaptive behaviors
Control	60	72.1 ± 7.5	70.4 ± 6.9	68.3 ± 8.2	65.7 ± 7.1	63.9 ± 6.8
Experimental	60	85.3 ± 6.2	82.7 ± 5.8	80.5 ± 5.9	78.4 ± 6.3	76.2 ± 5.7
t-value		9.87	9.63	8.45	9.21	9.78
p-value		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.2. Comparison of cognitive function between two groups of children

The cognitive executive function scores indicated that the working memory ability score of the experimental group reached (88.7 ± 5.8), with a significant improvement in attentional control ability, while the control group scored 76.4 ± 6.9, showing a statistically significant difference between the two groups ($p < 0.05$). See **Table 2**.

Table 2. Comparison of cognitive function between two groups of children

Group	n	Working memory	Attention control	Problem-solving	Cognitive flexibility	Information processing speed
Control	60	76.4 ± 6.9	74.2 ± 7.3	72.8 ± 6.5	70.5 ± 7.1	68.9 ± 6.4
Experimental	60	88.7 ± 5.8	86.5 ± 5.9	85.3 ± 5.7	83.7 ± 6.2	81.4 ± 5.8
t-value		9.54	8.92	9.87	8.76	9.34
p-value		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.3. Comparison of daily living abilities between two groups of children

The daily living independence score confirmed the functional improvement effect. The total self-care ability score of the experimental group was (90.2 ± 4.7), with a significant enhancement in tool-using ability, compared to 80.5 ± 5.3 in the control group, showing a significant difference between the groups ($p < 0.05$). See **Table 3**.

Table 3. Comparison of daily living abilities between the two groups of children

Group	n	Self-care skills	Instrumental activities	Social communication	Safety awareness	Environmental adaptation
Control	60	80.5 ± 5.3	78.2 ± 6.1	76.4 ± 5.9	74.3 ± 6.2	72.8 ± 5.7
Experimental	60	90.2 ± 4.7	88.7 ± 4.9	87.5 ± 4.8	85.6 ± 5.1	84.3 ±4.6
t-value		9.82	9.37	9.65	9.28	9.49
p-value		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.4. Comparison of social interaction abilities between the two groups of children

The data indicate that the experimental group demonstrated significantly enhanced social initiative, with a social skills score of (45.8 ± 3.2) compared to the control group's (38.7 ± 4.1), and notably improved emotional recognition ability. Analysis of social participation revealed that the frequency of positive interactions in the experimental group (89.5 ± 4.7) was significantly higher than that in the control group (76.3 ± 5.8), with $p < 0.05$. See **Table 4**.

Table 4. Comparison of social interaction abilities between the two groups of children

Group	n	Social Initiation	Emotion Recognition	Peer Interaction	Communication Willingness	Social Anxiety Index
Control	60	38.7±4.1	40.2±3.9	37.5±4.3	39.8±4.0	28.4±3.5
Experimental	60	45.8±3.2	47.6±3.1	46.2±3.4	48.5±3.2	22.1±2.8
t-value		8.97	9.85	9.63	9.42	9.78
p-value		<0.001	<0.001	<0.001	<0.001	<0.001

4. Discussion

Mental retardation is a relatively common disorder among children's neurodevelopmental disorders. Children with mental retardation may experience cognitive integration disorders or social avoidance behaviors due to abnormal sensory processing, leading to pathological reactions such as inadequate neural functional compensation. This presents a critical clinical issue in rehabilitation treatment. For a long time, traditional rehabilitation treatments have focused on single sensory stimulation or basic skill training, whereas the combined training program proposed in this study breaks through traditional limitations through multisystem collaborative intervention, significantly enhancing neural plasticity efficiency in practical applications. This study confirms that sensory integration training combined with cognitive training addresses the dimensional fragmentation issues of traditional rehabilitation by integrating vestibular-proprioceptive input with executive function training, including insufficient sensory threshold regulation, low cognitive transfer efficiency, and difficulties in behavioral generalization. At the neural mechanism level, joint training achieves bidirectional promotion of sensory information integration and cognitive restructuring, distinguishing it from traditional unidirectional stimulation models. The sensory integration ability score of the experimental group was (85.3 ± 6.2), which was significantly different from that of the control group (72.1 ± 7.5) ($p < 0.05$). This phenomenon can be attributed to the enhancing effect of joint training on synaptic plasticity. From a certain perspective, sensory integration training incorporates dynamic balance tasks that follow the developmental ladder principle, ranging from basic posture control and sensory discrimination to advanced cognitive integration and behavioral output, effectively promoting the optimization of neural pathways. Cognitive training guidance ensures that task difficulty is precisely matched, combined with real-time feedback and environmental adjustments, to minimize the common problem of training monotony. Structured guidance in sensory integration and cognitive training, such as multisensory integration tasks, problem-solving scenarios, and social story applications, breaks through sensory processing barriers, enhances the neural adaptability of children, and promotes the application of functional skills in real-world settings.

Compared with the control group undergoing conventional rehabilitation training, the experimental group implementing joint training showed significant improvements in both sensory processing efficiency and cognitive executive function after intervention (sensory integration ability in the experimental group: 85.3 ± 6.2, control group: 72.1 ± 7.5, $p < 0.05$), along with a marked increase in social participation (social skills score in the experimental group: 45.8 ± 3.2, control group: 38.7 ± 4.1, $p < 0.05$). The improvement in neurological function reflects the comprehensive benefits of rehabilitation. Enhanced cognitive flexibility and sensory integration abilities directly bolster environmental adaptability and improve daily functional performance. Combined training reduces incidents of sensory overload and improves emotional regulation. Improved social skills scores indicate the children's ability to understand social cues and navigate complex situations, reducing social avoidance behaviors. The optimization of neural network connectivity through combined training improves the sensory-cognitive-behavioral loop, directly promoting overall developmental progress. This multidimensional functional improvement aligns with the holistic development philosophy of modern rehabilitation medicine.

In terms of daily living skills, the experimental group's self-care ability was 90.2 ± 4.7, while the control group was 80.5 ± 5.3, with $p < 0.05$. Additionally, the experimental group's tool-use ability was 88.7 ± 4.9, compared to 78.2 ± 6.1 in the control group, with $p < 0.05$. These data validate the clinical value of combined training, demonstrating that sensory integration and cognitive training interventions can simultaneously enhance both basic functions and advanced skills, not only improving immediate task performance but also promoting skill transfer and application. However, neuroplasticity, as a complex function of age, intervention intensity, and individual differences, often exhibits nonlinear development. This dynamic nature of development constitutes a potentially incomplete predictive factor in the assessment of rehabilitation outcomes. Combined training effectively regulates sensory processing and cognitive function by directly converting sensory input into cognitive operations, strengthening neural feedback loops and behavioral adaptability. By leveraging the functional improvement effects derived from neurodevelopmental theories, it achieves the synergistic optimization of sensory integration, cognitive enhancement, and behavioral adaptation. Multiple longitudinal studies have observed significant improvements in neuroelectrophysiological indicators following combined training, with strong sustainability of effects, which is also highly consistent with the findings of this study.

The discoveries of this study hold significant clinical and theoretical implications. This study validates and reinforces the core theory of "sensory-cognitive-behavioral integrated development". However, neurorehabilitation cannot rely solely on a single dimension but must involve the systematic integration of sensory input, cognitive processing, and behavioral output. This provides a new perspective for child rehabilitation theory, emphasizing the dynamic interplay between sensory foundations, cognitive mediation, and behavioral manifestations. By quantifying multidimensional indicators, the study shifts rehabilitation interventions from an experience-based approach to an evidence-based one, such as significantly improving social participation metrics. This provides empirical support for maximizing the "window of neuroplasticity", bridging the gap between theoretical research and clinical practice. This study constructs a standardized training framework, utilizing structured task sequences for functional assessment, providing a methodological foundation for developing precise rehabilitation pathways for children and promoting the individualized development of rehabilitation medicine.

In terms of practical value, the combined training protocol proposed in this study has clear potential for clinical application. The protocol specifies training parameters, including sensory load gradients, cognitive task complexity, training duration allocation, and intensity modulation points, providing operational guidelines for clinical practitioners. This approach addresses the issue of ambiguous rehabilitation plans in traditional methods and facilitates easy implementation in primary healthcare institutions. It is particularly suitable for regions with limited resources, especially for children with coexisting sensory integration disorders and cognitive deficits, providing a basis for early intervention and family-based extended training. Based on standardized procedures, it ensures training quality while significantly enhancing rehabilitation efficiency and reducing the time cost for families, making it especially applicable to preschool children and an effective way to improve the accessibility of rehabilitation services. Family involvement in management directly promotes the generalization of training, which not only strengthens the maintenance of children's functions but also improves the quality of family life from a psychosocial perspective.

Looking ahead, this study has limitations in sample representativeness and suggests directions for further research. Firstly, the observation period of this study was 12 weeks, and long-term effects were not tracked; future research should expand the sample size and extend the follow-up period to further verify the durability of the effects. Secondly, differences in responses among different subtypes of children were not analyzed; future studies should conduct more detailed stratified analyses. Furthermore, this study focused on behavioral indicators and did not incorporate neuroimaging indicators such as electroencephalogram (EEG) and functional magnetic resonance imaging (fMRI), as well as dynamic changes in gene expression and biomarkers. Conducting multimodal assessments would hold significant value for exploring underlying mechanisms. Additionally, in terms of technological integration, future research could integrate virtual reality and wearable devices to create an intelligent closed-loop system for training, monitoring, and feedback, providing real-time personalized feedback and further enhancing the precision of interventions. Based on the findings of this study, a family-institution collaboration model can be developed in the future, and training parameter algorithms can be optimized to achieve continuity in rehabilitation services. Meanwhile, it is necessary to validate the applicability across different cultural backgrounds and expand the sample size to achieve cross-regional validation. Ultimately, the key challenge for the sustainable development of rehabilitation medicine lies in how to translate laboratory findings into community- and family-based practical solutions through policy support and service systems. To achieve this goal, it is recommended to establish a multi-center collaborative network and integrate digital health platforms to ultimately achieve efficient allocation of rehabilitation resources.

5. Conclusion

In summary, this study systematically explores the application of sensory integration training combined with cognitive training in the rehabilitation of children with mental retardation. The standardized training framework ensures comprehensive coverage of assessment dimensions, with sensory integration training taking the lead and various cognitive tasks working in coordination. The gradient design and dynamic adjustments prevent training fatigue. Family support provides continuous environmental support, addresses obstacles to skill transfer, and sustains functional development in children. The neurofeedback mechanism adjusts training loads in a timely manner, enhancing rehabilitation efficiency. The findings of this study hold certain theoretical innovative value, with significant practical application value and important implications for social promotion [7].

Funding

Baoding Science and Technology Plan Project (Project No.: 2541ZF307)

Disclosure statement

The authors declare no conflict of interest.

References

[1] Wang J, Zhang Q, 2025, Observation on the Effect of Sensory Integration Training Combined with Speech-Cognitive Function Training in the Treatment of Children with Language Delay. Chinese Journal of Health Preservation, 43(03): 152–155.

[2] Wang Y, Wang Y, Lv L, et al., 2024, Advances in the Application of Sensory Integration Training in Children with Developmental Delay. West China Medical Journal, 39(04): 660–664.

[3] Li H, Jiang L, 2023, Clinical Effect of Sensory Integration Training in the Treatment of Children with Language Delay. Intelligent Health, 9(01): 18–21.

[4] Ouyang N, 2019, Research on the Application Value of Sensory Integration Training in Improving the Abilities of Children with Psychomotor Developmental Delay. Contemporary Medicine, 25(07): 162–163.

[5] Yu E, Li J, Zhu N, 2022, The Impact of Sensory Integration Training on Behavioral Development in Children with Global Developmental Delay. Intelligent Health, 8(36): 79–82.

[6] Xiao J, 2024, The Effect of Repetitive Transcranial Magnetic Stimulation Combined with Sensory Integration Training in Promoting the Rehabilitation of Children with Psychomotor Developmental Delay. Medical Innovation of China, 21(02): 106–109.

[7] Luo W, 2021, The Impact of rTMS Combined with Cognitive Training on Intelligence and Social Adaptability in Children with Mental Retardation. Yunnan Medical Journal, 42(02): 133–135.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.