

Effects of Sensory Integration Training on Emotional–Behavioral Symptoms, Executive Function, and Attention in Children with Oppositional Defiant Disorder

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Abstract

Background: Oppositional defiant disorder is a type of disruptive behavior disorder that primarily involves difficulties with managing emotions and behaviors. The present study aimed to evaluate the efficacy of sensory integration training in improving emotional-behavioral disorders, executive function, and attention enhancement among students with oppositional defiant disorder.

Methods: This was a quasi-experimental study with a pre-test, post-test design. A convenience sample of 30 students diagnosed with oppositional defiant disorder in Kerman, Iran, between June and August 2023, was randomly assigned to either an experimental or control group (n=15 per group). The experimental group received sensory integration training twice a week, with 12 sessions lasting 60 minutes, while the control group received no intervention. The data were collected using the Coolidge Personality and Neuropsychological Inventory for Children (CPNI), the 18-item Oppositional Defiant Behavior Inventory (ODBI), the Behavioral Disorders Questionnaire (BDQ), and the Attentional Concentration Test (ACT; D2). Data were analyzed using paired t-tests for within-group comparisons and one-way ANOVA for between-group comparisons by SPSS version 25.

Results: Following the intervention, mean scores increased from pre-test to post-test in executive function (38.4 ± 7.4 to 42.5 ± 7.7) and attention (37.6 ± 10.7 to 40.1 ± 11.0), while emotional-behavioral disorder scores showed a slight decrease (29.6 ± 8.9 to 27.8 ± 8.7). Moreover, one-way ANOVA demonstrated that sensory integration training led to significantly greater improvements in emotional-behavioral disorders ($P=0.018$), executive function ($P=0.011$), and attention ($P=0.014$) compared with the control group.

Conclusions: The findings showed that sensory integration training is effective in reducing emotional-behavioral disorders, improving executive function, and strengthening attention in elementary school students in Kerman, Iran. Therefore, this intervention can be used to reduce the problems of children with oppositional defiant disorder.

Keywords: Sensory Integration Training, Emotional-behavioral Disorders, Executive Function, Attention, Children, Oppositional Defiant Disorder

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1. Introduction

Childhood emotional-behavioral disorders have garnered significant research in recent decades. Oppositional defiant disorder (ODD), as defined by the DSM-5, is characterized by a persistent (at least six months) pattern of angry/irritable mood, argumentative/defiant behavior, or vindictiveness. Affecting 1% to 11% of preschool and early school-age children, ODD is slightly more prevalent in pre-adolescent boys than girls (1). The rising incidence of emotional-behavioral disorders in children raises concerns about mental health and its effects on development and functioning (2). A review of developmental psychopathology classifies

childhood emotional-behavioral disorders into two main categories: internalizing and externalizing disorders. Internalizing disorders encompass mood disorders (such as major depression, mild depression, and bipolar disorder), self-awareness issues, anxiety, withdrawal, shyness, and certain physical problems experienced during development.

In contrast, externalizing disorders, including conduct disorder, oppositional defiant disorder, and attention-deficit/hyperactivity disorder, primarily involve behaviors that impact the environment and others (3). Oppositional defiant disorder is one of the most common childhood mental health

diagnoses in non-clinical populations. It falls under the category of conduct disorders, characterized by a persistent pattern of aggressive or irritable behavior, argumentative confrontations, and snobbery. Children with this disorder often exhibit irritability, anger, defiance toward authority figures, and a tendency to intentionally provoke or criticize others for their mistakes (4). This disorder has a poor prognosis, with affected children often facing social adjustment issues (5), negative emotions (6), and academic and occupational challenges (7). A common issue that hinders their performance in activities and school is attention deficit (8). Selective attention is the ability to focus on a specific stimulus or activity, which is linked to the capacity to shift attention.

Three neural networks are central to attention: positioning, alertness, and executive attention (9). Children with oppositional defiant disorder also exhibit poor executive functioning, a key component of cognitive and metacognitive skills. Currently, executive functions are a major focus of neuropsychological theories regarding students at risk for emotional and behavioral disorders (10). Executive functions, the cognitive processes that oversee and guide our thoughts, actions, and emotions, include abilities such as reasoning, language comprehension, and visual-spatial skills (11, 12). A study conducted by Brænden and colleagues highlighted a concerning trend of a significant rise in the prevalence of executive function disorders among students attending schools (13). These cognitive functions are mental tools that help individuals decide how to behave and are connected to processes responsible for focusing attention, reasoning, and carrying out tasks (1). The development of executive functions is essential for cognitive and metacognitive growth, impacting self-regulation and the advancement of social and emotional abilities. A child's neuropsychological functions are closely linked to the frontal cortex and undergo significant changes as they grow (14). Capodieci and co-workers found that students with attention and learning difficulties tend to struggle on tests of executive functions and working memory (15).

It was discovered that students who have emotional behavioral disorders have compromised executive functions when compared with their peers (16). Given the high prevalence and dangers associated with this condition, it is important to conduct further research to determine its causes and treatments. One

potential method is sensory integration therapy, which focuses on how information is processed through senses such as vision, hearing, touch, and balance. This therapy encourages children to participate in fun activities to enhance their sensory coordination and improve their sensory abilities (17). Attention is important for promoting integration and successful learning, particularly in treating oppositional defiant disorder. According to sensory integration theory, there is a connection between struggles with processing sensory input and difficulties with developing motor skills (18). Sensory integration therapy involves organizing sensory input for day-to-day tasks and activities. Key components of this therapy include developing sensory abilities, supporting student achievement, boosting confidence in physical safety, facilitating self-regulation, and building unity, all of which are crucial for addressing sensory integration issues. Research indicated that sensory integration therapy benefits children with emotional and behavioral problems (19-21). Oppositional defiant disorder (ODD) negatively impacts children's academic performance and burdens schools. Effective interventions can address the challenges faced by children with ODD and their families. Early treatment is crucial, as behavioral issues often begin in childhood. Sensory integration training shows promise for improving executive function and attention, and reducing emotional-behavioral disorders, thus supporting children's healthy development. Given the limited research on this topic, particularly concerning children with ODD, this study aimed to investigate the effectiveness of sensory integration training on emotional-behavioral disorders, executive function, and attention in second-grade children in Kerman, Iran.

2. Methods

2.1. Design

This was a quasi-experimental study with a pre-test and post-test design, conducted in Kerman, Iran, between June and August 2023.

2.2. Selection and Description of Participants

The sample included 30 students diagnosed with oppositional defiant disorder by a therapist, selected through convenience sampling from counseling and psychotherapy centers in Kerman, Iran, and agreed to participate in the study.

2.3. Sample Size Determination

To ensure sufficient statistical power for the study, a sample size calculation was performed using G*Power software. This calculation aimed to achieve an alpha level of 0.05 and a power of 0.90. Prior research provided the basis for these calculations, reporting post-test means of 21.70 ± 2.61 for emotional-behavioral disorders and 18.60 ± 2.44 for the sensory integration training (22). The study participants were randomly assigned to one of two groups (experimental and control). The participants ($n=30$) were assigned unique identification numbers (1-30) and then randomized to either the experimental (odd numbers) or control (even numbers) group. This ensured equal group sizes of 15 participants (Figure 1). The inclusion criteria for the study were: a confirmed diagnosis of oppositional defiant disorder by a psychologist or psychiatrist at a treatment center, parental consent, the absence of other psychological disorders such as developmental disorders, and the absence of physical disorders such as epilepsy, visual, auditory, or motor impairments. The exclusion criteria included: incomplete or corrupted questionnaires and missing more than three sessions of the intervention program.

2.4. Data Collection and Measurements

2.4.1. The Coolidge Personality and Neuropsychological Inventory for Children (CPNI): The inventory is a test for assessing neurocognitive and behavioral disorders in children and adolescents aged 5 to 17 years (23). This is a pen-and-paper questionnaire for parents, based on the American Psychiatric Association (1994) criteria. Two subscales focus on executive functions, covering 19 items related to organizing, decision-making/planning, and inhibiting. Higher scores indicate greater severities in each subscale, with reliability coefficients of 0.85, 0.60, and 0.74 for organizing, decision-making/planning, and inhibiting, respectively (23). The validity of the inventory was confirmed with a CVI of 0.89 and a CVR of 0.81 (24). Additionally, the internal consistency in this study is reported to be 0.76, calculated by using Cronbach's alpha.

2.4.2. The 18-item Oppositional Defiant Behavior Inventory (ODBI): This questionnaire was developed by Harada and colleagues and has 18 items filled out by the child's parents. Each question is scored on a four-point Likert scale from 0 to 3, with a total range of 0 to 54 (25). If the score

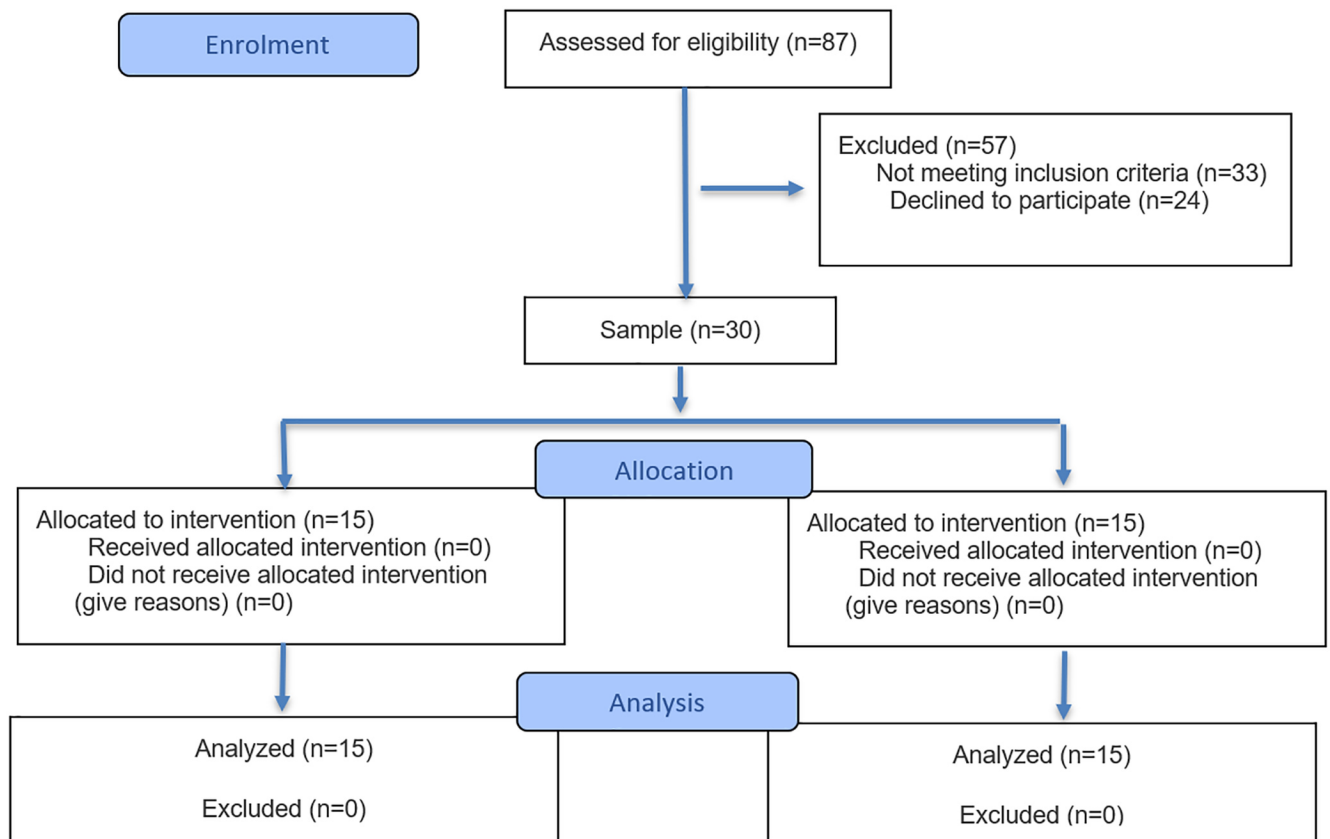


Figure 1: The figure shows the CONSORT flow diagram of the study.

is greater than 20, the diagnosis of oppositional defiant disorder is given, and the closer the score is to 54, the greater the severity of the disorder. The internal validity of this test was assessed using Cronbach's alpha (0.76) and test-retest (0.82). The questionnaire's validity was confirmed with a CVI of 0.84 and a CVR of 0.81 (26). In our study, Cronbach's alpha was 0.78.

2.4.3. Behavioral Disorders Questionnaire (BDQ): The Rutter Children's Form Questionnaire for parents and teachers assesses behavioral disorders. Developed by Rutter in 1964 and revised in 1967, the questionnaire distinguishes between normal children and those with behavioral issues (27). The questionnaire has high test-retest reliability (0.89). Its validity, indicated by a significant correlation (0.85) with psychiatrists' diagnoses, is statistically significant at P value of 0.001. Rutter (27) suggested that a total score differentiates normal children from those with emotional behavioral disorders. In Iran, the questionnaire has high internal reliability, with a Cronbach's alpha of 87% (28). The validity of the scale was confirmed with a CVI of 0.86 and CVR of 0.87 (28). In our study, Cronbach's alpha was 0.80.

2.4.4. Attentional Concentration Test (ACT; D2): This test, developed by Brickenkamp and Cubero to assess children's attention, effort, error rate, and concentration, is now recognized internationally for its accuracy (29). Standardized by Rezaei and colleagues, its validity was confirmed with a coefficient of 0.91 (30). The validity of the children's attention questionnaire was confirmed with CVI and CVR of 0.82 and 0.85, respectively (30). In our study, Cronbach's alpha was 0.91.

2.5. Procedure

After receiving research approval, the researcher referred to one of the psychological counseling centers in Kerman, Iran. To determine the research sample, the researcher initially identified 87 students with oppositional defiant disorder who met the inclusion criteria through convenience sampling at this center. During a screening process conducted by the researcher, mothers completed the questionnaires, and the researcher identified 56 children who obtained the lowest scores on the instrument, based on the instrument's instructions. Following attrition, 30 children were included in the study. These children were then randomly

assigned by the researcher to two groups (15 in the sensory integration group, and 15 in the control group). The researcher conducted a pre-test across all two groups, followed by a 12-session sensory integration program, each lasting 60 minutes and implemented twice a week for the experimental group (22). The control group received no intervention. A summary of the intervention sessions is presented in Table 1. Post-tests were then administered to the two groups by the researcher. To ensure ethical considerations, the researcher provided parents and children with information about the study in advance. Participants were given the right to withdraw from the study, and informed consent was obtained.

2.6. Data Analysis

Data were analyzed using paired t-tests for within-group comparisons and one-way ANOVA for between-group comparisons. Preliminary analyses involved calculating descriptive statistics (mean and standard deviation) for each group at the pre-test and post-test stages. The normality of the data distribution was assessed using the Shapiro-Wilk test, and the homogeneity of variance was evaluated using Levene's test. Independent T-test and chi-square tests examined the distribution of categorical variables. Statistical analyses were performed in SPSS version 25.

3. Results

This study involved 30 students with oppositional defiant disorder, randomly assigned to two groups: a sensory integration training group (n=15) and a control group (n=15). A chi-square test showed no significant difference in gender distribution between the groups ($P=0.80$). The sensory integration training group comprised 11 participants from 4th grade, 11 from 5th grade, and eight from 6th grade. A chi-square test indicated no significant difference in educational level distribution among the groups ($P=0.70$) (Table 2).

Table 3 shows that the paired t-test indicated significant differences between pre-test and post-test scores for emotional-behavioral disorders ($P=0.024$), executive function ($P=0.006$), and attention enhancement ($P=0.021$) in the experimental group. However, the differences between the control group's pretest and post-test scores were insignificant ($P>0.05$). One-way

Table 1: A summary of sensory integration program sessions

Sessions	Content
1	Describing the treatment process for the mother, answering the mother's questions, and conducting a pre-test
2	Jumping inside the tire, moving and stopping the tire with both feet in and out of the tire, jumping on the tire, standing and maintaining their balance
3	Walking back and forth on the ground ladder with the right and left foot, walking slowly down the ground ladder, then moving forward, backward, and sideways between the two ladder frames
4	Stimulating the tactile system of the child's fingers by using a toothbrush, rolling over, walking with (hips), standing next to the wall, turning completely in one direction and then in the opposite direction, and rubbing the ball several times on the child with a towel
5	Jumping rope using equipment such as a rocking chair and trampoline, slide, and swing
6	Transporting competition equipment, pulling rope, crumpling newspapers, throwing heavy balls, pushing heavy object, and throwing the ball into the basket
7	Blowing on a ping pong ball, imitating animal walking, jumping on a pair of feet, rolling the ball over the wall, shooting backwards, shooting forwards, climbing ladders, and moving in a certain direction
8	Biking and rope playing with a different direction detection program
9	Finding the differences and similarities in the shapes given to the student, showing objects to the student for 30 seconds, then hiding them from his view, and explaining what he saw
10	Starting with words, saying the words, adding more words, listening to the sounds of different recorded voices and recognizing the sounds, using short stories and asking the child about the events of the story
11	Using word and picture cards, seeing children's pictures and then recognizing them, finding shapes according to their color and size
12	Catching the ball with the right hand and the left hand, undoing the bolt with the dominant hand and the non-dominant hand, cutting the geometric shapes designed by the child, and putting the matchsticks in the box

Table 2: Demographic characteristics of the participants

Variable	Demographic Status	Groups		Chi-Square	P value
		Experimental	Control		
Age	Mean±SD	10.85±0.75	10.93±0.86	11.40	0.48
Gender	Female	4	3	5.40	0.80
	Male	11	12		
Educational level	4th Grade	6	5	0.44	0.70
	5th Grade	5	6		
	6th Grade	4	4		

SD: Standard Deviation

Table 3: Comparison of emotional-behavioral disorders, executive functioning, and attention between the groups

Variables	Phases	Intervention Group	Control Group	P (between-group)
		Mean±SD	Mean±SD	
Emotional-Behavioral Disorders	Pre-test	29.6±8.9	29.7±8.6	0.736
	Post-test	27.8±8.7	29.6±8.3	0.018
	P (within-group)	0.024	0.740	-
Executive Functioning	Pre-test	38.4±7.4	35.867±7.6	0.508
	Post-test	42.5±7.7	35.800±8.2	0.011
	P (within-group)	0.006	0.378	-
Attention	Pre-test	37.6±10.7	37.267±10.2	0.228
	Post-test	40.1±11.0	37.1±10.2	0.014
	P (within-group)	0.021	0.586	-

ANOVA also showed significant differences between the sensory integration training group and the control group in the mean scores for emotional-behavioral disorders ($P=0.018$), executive function ($P=0.011$), and attention enhancement ($P=0.014$). Thus, it could be said that sensory integration training effectively decreased emotional-behavioral

disorders and increased executive function and attention.

4. Discussion

This study aimed to examine the impact of sensory integration training on emotional-

behavioral disorders, executive function, and attention in students with oppositional defiant disorder (ODD) in Kerman, Iran. The findings indicated that sensory integration training effectively reduces emotional-behavioral disorders and enhances executive function and attention in these children. The results of our hypothesis investigation were consistent with prior research (17, 20, 21-31).

The findings of this study indicated that sensory integration training can effectively reduce emotional-behavioral disorders in students with ODD. These results aligned with a study conducted by Shakeri and colleagues (3), which demonstrated that psychotherapeutic interventions positively impact conduct disorder. While the study by Shakeri and colleagues highlighted the benefits of various psychotherapeutic approaches in alleviating symptoms of conduct disorder, the present research specifically focuses on sensory integration training as a practical and targeted intervention (3). Additionally, the results showed that children undergoing sensory integration training improved their executive functioning. This finding was consistent with the research by Granero and colleagues, which indicated that socioeconomic status and parenting styles significantly influence executive functioning. While the study by Granero and colleagues emphasized the role of social factors, the present study suggested that practical interventions, such as sensory integration training, can enhance executive functioning without necessitating changes in these social factors (6).

Furthermore, the study demonstrated that sensory integration training improves attention in students with ODD. These findings were consistent with those of Inci Izmir and colleagues, who explored the relationship between sensory integration and core symptoms of ADHD and concluded that sensory integration can enhance attention in children. However, this study specifically examined the direct impact of sensory integration training on students with ODD (12). Despite these positive outcomes, some studies reported different results. For instance, Carlson and colleagues concluded that social and communicative factors may exert a more substantial influence on emotional-behavioral disorders, suggesting that sensory integration interventions alone might not yield comparable results. This discrepancy could stem from variations in study

design, intervention types, and the populations studied (2). Moreover, while the present study indicated improved executive functioning among children receiving sensory integration training, Granero and colleagues argued that social factors and parenting styles might play a more significant role in executive functioning. This inconsistency suggests that sensory integration interventions alone may not suffice to enhance executive functioning in complex social contexts and may require multifaceted approaches (6). Regarding the impact of sensory integration training on attention, although this study found that such training can improve attention, Li and colleagues emphasized that sensory integration should be combined with cognitive interventions to achieve optimal effects. This discrepancy may be attributed to differences in the types of interventions and the characteristics of the study samples (31).

Sensory integration involves receiving and processing information from the senses of movement, touch, pressure, vision, hearing, taste, and smell. In behavioral disorders like oppositional defiant disorder, sensory information may be processed inaccurately. By enhancing the coordination of visual, auditory, and motor skills, various challenges faced by these students can be addressed (20, 21). The sensory integration method aims to strengthen higher brain functions and improve the efficiency of abstract thinking, thereby positively influencing emotional-behavioral disorders, executive function, and attention in children. This approach emphasizes giving children better control over sensory input, specifically vestibular, proprioceptive, and tactile stimuli. During the intervention, the therapist helps the child develop an adaptive response, which is essential for integrating sensory information (20).

Many of these children struggle with executive functions, attention, and emotional regulation, leading to increased vulnerability to emotional and mental disorders. Sensory integration interventions enhance problem-solving, attention, reasoning, organization, planning, memory, inhibitory control, impulse control, and orientation, facilitating coordination among various senses. These exercises involve motor and tactile pathways, helping children better visualize social situations, understand themselves and others, and mitigate emotional disorders (17, 31).

4.1. Limitations

The main limitations of the present study included its focus on male students in grades four to six with oppositional defiant disorder in Kerman, Iran, which may limit the generalizability of the results to other populations. Data were collected through self-report questionnaires, which can be skewed by respondents' tendency to provide socially desirable answers. Additionally, the absence of follow-up stages was a notable limitation. Future research should use larger samples and include follow-up periods to assess the sustained effectiveness of the intervention. Comparative studies between sensory integration therapy and other treatments for oppositional defiant disorder are also recommended. More accurate assessment tools, such as clinical interviews and storytelling, could replace self-report methods. The study's findings should inform risk identification and interventions for students who exhibit disobedience.

5. Conclusions

The findings of the present study indicated that sensory integration training is an effective intervention for reducing emotional-behavioral disorders and improving executive function and attention in children with oppositional defiant disorder. These results highlight the value of incorporating sensory-based interventions into educational and therapeutic programs for children with ODD. Early and targeted sensory integration training may contribute to improved cognitive functioning and behavioral regulation, thereby supporting better academic and psychosocial outcomes.

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Authors' Contributions

Masoumeh Moslemi: Substantial contributions to the conception and design of the work, acquisition, analysis, and interpretation of data for the work; drafting the work. Azam Vaziri nasab: Substantial contributions to the conception

and design of the work, acquisition, analysis, and interpretation of data for the work; drafting the work and reviewing it critically for important intellectual content. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work, such as the questions related to the accuracy or integrity of any part of the work.

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Ethical Approval

The Ethics Review Board of Islamic Azad University, Kerman Branch, Kerman, Iran, approved the present research with the code of IR.IAU.KERMAN.REC.1402.112. Also, written informed consent was obtained from the participants.

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