

# Comparison of the Effectiveness of Mindfulness Intervention and Perceptual–Motor Games on Attention Problems in Students with Attention-Deficit/Hyperactivity Disorder

Hamideh. Firouzan Qazalgeh<sup>1</sup>, Mahin. Etemadinia<sup>2\*</sup>, Ali. Khademi<sup>2</sup>

<sup>1</sup> PhD Student, Department of Psychology, Ur.C., Islamic Azad University, Urmia, Iran

<sup>2</sup> Department of Psychology, Ur.C., Islamic Azad University, Urmia, Iran

\* Corresponding author email address: mahin\_etemadinia@iau.ac.ir

### Article Info

#### Article type:

Original Research

#### How to cite this article:

Firouzan Qazalgeh, H., Etemadinia, M., & Khademi, A. (2026). Comparison of the Effectiveness of Mindfulness Intervention and Perceptual–Motor Games on Attention Problems in Students with Attention-Deficit/Hyperactivity Disorder. *Psychological Research in Individuals with Exceptional Needs*, 4(2), 1-12.  
<https://doi.org/10.61838/kman.prien.5612>



© 2026 the authors. Published by KMAN Publication Inc. (KMANPUB), Ontario, Canada. This is an open access article under the terms of the Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License.

### ABSTRACT

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders in children and is associated with deficits in attention and executive functioning. Given the limitations of pharmacological treatments, the present study aimed to compare the effectiveness of mindfulness training and perceptual–motor games on attention problems in students with ADHD. The study employed an experimental design with pretest, posttest, follow-up, and a control group. The statistical population consisted of all male students in the fourth to sixth grades of elementary school in Tabriz during the 2024–2025 academic year. A sample of 45 participants was selected using a multistage cluster sampling method and randomly assigned to three groups of 15 participants each (mindfulness, perceptual–motor games, and control). Research instruments included the Child Symptom Inventory-4 (CSI-4) and the Conners Neuropsychological Scale. Data were analyzed using repeated-measures analysis of variance and the Bonferroni post hoc test. The findings indicated that both interventions significantly reduced attention problems ( $p < .05$ ). The observed effects remained stable at the six-week follow-up assessment. Comparison of group means demonstrated that perceptual–motor games were more effective than mindfulness training. Mindfulness and perceptual–motor game interventions can be utilized as complementary strategies for reducing attention problems in children with ADHD. Furthermore, the findings suggest greater durability of the effects of multisensory and motor-based activities compared to cognitive training exercises. It is recommended that these interventions be implemented in schools and rehabilitation centers and be further investigated in future studies with larger samples and longer follow-up periods.

**Keywords:** Attention-Deficit/Hyperactivity Disorder (ADHD), mindfulness, perceptual–motor games, attention problems, students.

## 1. Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders of childhood and is characterized by persistent patterns of inattention, hyperactivity, and impulsivity that interfere with academic, behavioral, social, and developmental functioning. ADHD is not limited to overt behavioral restlessness; rather, it involves impairments in attentional control, inhibitory regulation, executive functioning, motor coordination, emotional regulation, and adaptive classroom behavior. Epidemiological evidence has consistently shown that ADHD is highly prevalent among school-aged children and may continue into adolescence and adulthood if not properly identified and managed (Dobrosavljevic et al., 2020; Venkata & Panicker, 2013). Broader developmental disability trends also indicate that neurodevelopmental conditions, including ADHD and related learning and behavioral disorders, represent a major concern in child mental health and educational systems (Zablotsky et al., 2019). Because primary school is a critical developmental period for the formation of academic habits, behavioral self-regulation, peer relationships, and cognitive control, attention problems during this stage can produce cumulative consequences that extend beyond the classroom.

Attention problems in children with ADHD often manifest as difficulty sustaining concentration, distractibility, poor task completion, impulsive responding, disorganization, and inconsistent academic engagement. These problems are closely related to deficits in executive functions, including inhibition, working memory, cognitive flexibility, planning, and monitoring of behavior. From a neuropsychological perspective, children with ADHD may experience difficulties in selecting relevant stimuli, maintaining attention over time, shifting attention between tasks, dividing attention when multiple demands are present, and preserving adequate attentional span. Such difficulties directly interfere with learning activities, classroom participation, and accurate response production. Studies on computerized attention assessment and executive function measurement emphasize the importance of precise evaluation of attentional performance in children with learning and developmental difficulties (Rafikhah et al., 2021; Wang & Huang, 2012). Since attention is a foundational cognitive process for reading, writing, mathematics, and problem solving, impairments in this domain can affect nearly every aspect of school performance.

The educational consequences of ADHD are particularly important because ADHD frequently co-occurs with specific learning disorders and other developmental difficulties. Research has shown that ADHD and specific learning disorders can jointly impair academic performance, especially among children from socioeconomically vulnerable backgrounds (Español-Martín et al., 2023). Difficulties in mathematical learning, enumeration, and cognitive processing among adolescents with learning disorders further suggest that attentional and executive dysfunctions may interact with academic skill deficits in complex ways (Ceulemans et al., 2021). Retrospective evidence on learning difficulties also indicates that untreated developmental and learning-related problems may show continuity across the lifespan and may be associated with later psychosocial risks (Zakopoulou et al., 2014). Therefore, interventions targeting attention problems in children with ADHD should not be considered merely symptom-reduction strategies; they are also preventive educational and developmental approaches aimed at reducing long-term academic and psychosocial vulnerability.

In addition to academic impairments, ADHD affects children's emotional and social functioning. Children with ADHD symptoms may experience peer rejection, reduced social competence, interpersonal conflict, and social isolation. Longitudinal findings indicate that ADHD symptoms can be associated with later social isolation, demonstrating that attention and behavioral regulation problems may gradually disrupt peer relationships and social participation (Katherine et al., 2023). Parenting and family functioning are also relevant to ADHD, as parental ADHD symptoms, family stress, and behavioral management difficulties can affect children's emotional and behavioral development (Johnston et al., 2012). Accordingly, interventions that strengthen attentional control, emotional regulation, and behavioral self-management may contribute not only to cognitive improvement but also to better interpersonal adjustment. Evidence from mood regulation skills training among students with learning disabilities also supports the broader idea that psychological and regulatory interventions can improve self-concept and social competence in children with developmental difficulties (Afrouz et al., 2014).

Although pharmacological treatment is widely used for ADHD, medication is not sufficient for all children and may be associated with limitations such as side effects, variable adherence, incomplete response, and limited effects on some

academic, emotional, and social outcomes. As a result, non-pharmacological interventions have gained increasing attention in clinical, educational, and rehabilitation contexts. Classroom-based interventions can reduce off-task and disruptive behaviors among children with ADHD symptoms, highlighting the importance of structured behavioral and educational strategies within the school environment (Gaastra et al., 2016). Similarly, neuropsychological and cognitive interventions have been proposed for children with specific learning and attentional difficulties, emphasizing the need to strengthen underlying cognitive processes rather than focusing only on observable behavior (Sadasivan, 2013). Digital cognitive training protocols also reflect the growing interest in structured, non-pharmacological methods for improving cognitive control in children with ADHD (Richmond et al., 2022). These developments suggest that multimodal and complementary interventions may be especially valuable for students whose attention problems affect both learning and behavior.

Among non-pharmacological interventions, mindfulness-based approaches have received increasing empirical attention. Mindfulness refers to intentional, present-moment awareness accompanied by nonjudgmental acceptance of internal and external experiences. In children with ADHD, mindfulness training is assumed to improve attention by strengthening awareness of distraction, reducing automatic reactions, enhancing emotional regulation, and increasing the capacity to pause before responding impulsively. Early evidence demonstrated that mindfulness training can improve attentional functioning and reduce behavioral problems among adolescents with ADHD (van de Weijer-Bergsma et al., 2012). More recent studies have also emphasized the role of mindfulness-based training in improving attention, impulsivity, and emotional regulation among children with ADHD, particularly when family engagement is integrated into the intervention process (Elzohairy et al., 2024). Systematic review evidence further supports the potential effectiveness of mindfulness programs for children and adolescents with ADHD, although differences in intervention structure, duration, participant age, and outcome measures indicate that additional comparative research is still needed (Sultan et al., 2025).

Mindfulness may be particularly relevant for children with attention problems because it directly trains the monitoring of attention. Through exercises such as mindful breathing, body scanning, mindful movement, and awareness of thoughts and emotions, children learn to recognize when their attention has drifted and to redirect it

toward a selected focus. This process may strengthen sustained attention, reduce distractibility, and improve self-regulation. Mindfulness-based interventions may also help children manage frustration, anxiety, and impulsive emotional responses that often accompany ADHD. However, mindfulness requires cognitive engagement, instruction-following, and repeated internal monitoring, which may be challenging for younger children with severe inattention or hyperactivity. Therefore, while mindfulness is theoretically and empirically promising, it is important to compare its effectiveness with more activity-based interventions that may better fit the developmental characteristics of children with ADHD.

Perceptual–motor interventions represent another important non-pharmacological approach for children with ADHD. These interventions are based on the premise that attention, perception, movement, and executive control are developmentally interconnected. Human motor development involves the gradual integration of sensory processing, postural control, coordination, spatial orientation, and goal-directed movement, all of which contribute to adaptive learning and behavior (Pain & Laridi, 2016). Children with ADHD frequently show difficulties in motor coordination, fine motor control, timing, balance, and sensory–motor integration. Fine motor training has therefore been examined as a potentially useful intervention for children with ADHD, with systematic review evidence suggesting that motor-based programs may contribute to improvements in motor and functional outcomes (Lelong et al., 2021). Equine therapy has also been shown to affect psychological indicators and sensory–motor functioning in children with ADHD, supporting the therapeutic potential of movement-based and sensory-rich activities (Amini et al., 2019).

Physical activity and motor-based interventions may improve attention through several mechanisms. Structured movement activities can increase arousal regulation, enhance inhibitory control, improve working memory, strengthen motor planning, and provide immediate feedback through sensory channels. Evidence indicates that physical activity can improve executive function and motor performance in children with ADHD (Ziereis & Jansen, 2015). More recent meta-analytic findings also show that physical activity interventions can positively affect executive function in children, while long-term exercise may improve motor skills in children with ADHD (Li, 2025; Wang et al., 2025). Network meta-analytic evidence further suggests that different forms of physical activity may vary in

their effects on inhibitory control, highlighting the need to identify which types of movement-based interventions are most beneficial for children with ADHD (Zhao et al., 2025). These findings provide a strong rationale for using perceptual–motor games as structured, engaging, and developmentally appropriate interventions for attention problems.

Perceptual–motor games are particularly suitable for school-aged children because they combine cognitive demands with playful movement. Activities such as balance tasks, obstacle navigation, ball throwing and catching, puzzles, tangrams, bead threading, visual discrimination tasks, auditory recognition, maze completion, and directionality games require children to coordinate attention, perception, movement, and behavioral control. These games may simultaneously engage selective attention, sustained attention, visual–spatial processing, eye–hand coordination, inhibitory control, and task persistence. Compared with purely cognitive interventions, perceptual–motor games may be more motivating for children with ADHD because they provide novelty, movement, social interaction, and immediate task-based feedback. Prior evidence comparing verbal self-instruction and perceptual–motor games has shown that perceptual–motor activities can improve attention span in students with ADHD (Ghasabi et al., 2018). Follow-up evidence on perceptual–motor skill reconstruction programs also suggests that the effects of such interventions may be sustainable over time (Soltani Kouhbanani & Rothenberger, 2021).

The comparison between mindfulness and perceptual–motor interventions is important because both approaches target attention but do so through different mechanisms. Mindfulness emphasizes internal awareness, cognitive monitoring, emotional self-regulation, and attentional redirection. In contrast, perceptual–motor games rely on external stimuli, bodily movement, sensory integration, coordination, and play-based executive control. Existing evidence suggests that both mindfulness exercises and perceptual–motor exercises can influence attention networks and response accuracy in children with ADHD (Pirian & Farsi, 2020). However, the relative effectiveness of these two approaches remains insufficiently clarified, especially in school-based samples of elementary students. Children with ADHD may respond differently depending on whether the intervention is cognitively reflective or physically active. Therefore, direct comparison of these two intervention modalities can help educators, psychologists, and

rehabilitation specialists choose more effective complementary strategies.

The need for such comparison is also reinforced by the multidimensional nature of ADHD. Biological research, including transcriptome profiling in adult ADHD, indicates that ADHD has complex neurodevelopmental and neurobiological foundations (Mortimer et al., 2020). Yet the functional expression of ADHD in children is shaped by classroom demands, family context, motor development, cognitive skills, and emotional regulation. This complexity implies that no single intervention can address all aspects of ADHD equally. Mindfulness may be more directly associated with self-awareness and emotional regulation, whereas perceptual–motor games may be more directly associated with sensory–motor integration, attention engagement, and executive control in action. Therefore, examining both interventions within one experimental design can provide clearer evidence regarding their comparative effects on attention problems.

Despite growing research on ADHD interventions, several gaps remain. First, many studies examine either mindfulness-based programs or movement-based programs independently, without direct comparison. Second, fewer studies have focused specifically on elementary school students, even though this period is crucial for academic adjustment and intervention responsiveness. Third, follow-up assessment is often limited, making it difficult to determine whether improvements remain stable after the intervention ends. Fourth, many intervention studies focus on global ADHD symptoms rather than specific attention components such as selective attention, sustained attention, divided attention, attentional shifting, and attention span. Addressing these limitations can strengthen evidence-based educational and rehabilitation planning for children with ADHD.

Considering the high prevalence of ADHD, its adverse academic and social consequences, and the need for effective non-pharmacological interventions, the present study was designed to compare two theoretically distinct but practically applicable approaches: mindfulness training and perceptual–motor games. Both interventions can be implemented in school and rehabilitation settings, require limited equipment, and may be adapted to the developmental needs of children. However, determining their relative effectiveness is essential for designing targeted intervention programs. Based on previous evidence, it can be expected that both interventions will reduce attention problems, but perceptual–motor games may produce stronger effects

because they combine multisensory stimulation, motor engagement, executive control, and playful motivation.

The aim of the present study was to compare the effectiveness of mindfulness intervention and perceptual–motor games on attention problems among elementary school students with Attention-Deficit/Hyperactivity Disorder.

## 2. Methods and Materials

### 2.1. Study Design and Participants

This study employed an experimental design with pretest, posttest, and follow-up assessments alongside a control group to investigate the comparative effectiveness of mindfulness training and perceptual–motor games on attention problems among students diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD). Three groups participated in the study, including two experimental groups and one control group. The first experimental group received mindfulness training, whereas the second experimental group participated in a perceptual–motor games program. The control group did not receive any intervention during the study period. Assessments were conducted at three time points, including pretest, posttest, and follow-up, allowing the evaluation of intervention-related changes and the persistence of treatment effects over time.

The study population consisted of all male students enrolled in the fourth, fifth, and sixth grades of elementary schools in Tabriz during the 2024–2025 academic year. Participants were selected through a multistage cluster sampling procedure. Initially, one educational district was randomly selected from the five educational districts of Tabriz. Subsequently, five boys' elementary schools were randomly chosen from the selected district. After receiving appropriate instructions, classroom teachers completed the Child Symptom Inventory-4 (CSI-4) for all students in their classes. Students who obtained scores above the cutoff point of 32 were invited to participate in a clinical evaluation. The final diagnosis of ADHD was established through a structured clinical interview based on the criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5). Students receiving medication treatment or presenting comorbid conditions such as conduct disorder or learning disabilities were excluded. After applying all inclusion and exclusion criteria, 45 eligible students were identified and randomly assigned to three groups of equal size, with 15 participants in each group.

Inclusion criteria consisted of a confirmed ADHD diagnosis according to DSM-5 criteria, achievement of the cutoff score on the CSI-4, enrollment in grades four through six, male gender, an intelligence quotient above 90 as assessed by Raven's Progressive Matrices, and no use of psychiatric medication during the study. Exclusion criteria included initiation of medication treatment during the study, presence of comorbid conduct or learning disorders, an intelligence quotient below 90, and absence from more than two intervention sessions.

### 2.2. Measures

The Child Symptom Inventory-4 (CSI-4) was used as the screening instrument for identifying students with ADHD symptoms. Originally developed by Gadow and Sprafkin and later revised to correspond with DSM-IV diagnostic criteria, the CSI-4 is a comprehensive behavioral rating scale designed to assess emotional and behavioral disorders among children aged 5 to 12 years. The instrument includes both parent and teacher forms. The teacher version contains 77 items and evaluates a broad range of behavioral and emotional problems observed in school settings, including ADHD, oppositional defiant disorder, conduct disorder, anxiety disorders, tic disorders, mood disturbances, and developmental disorders. Items are rated on a four-point Likert scale ranging from 0 (never) to 3 (very often). The instrument allows both symptom severity scoring and screening through cutoff scores. Previous studies have reported satisfactory psychometric properties, including test–retest reliability coefficients ranging from .67 to .76. Iranian validation studies have demonstrated internal consistency coefficients between .90 and .93 and high levels of sensitivity and specificity for identifying ADHD. In the present study, the teacher version of the CSI-4 was employed to identify eligible participants and confirm the presence of clinically significant ADHD symptoms.

Attention performance was assessed using the Conners Neuropsychological Scale, developed by Conners in 2004 to evaluate different aspects of attention among children aged 5 to 12 years. The scale consists of 14 items scored on a four-point scale ranging from “not observed” to “severe.” It measures five dimensions of attention, including selective attention, sustained attention, attentional shifting, divided attention, and attention span. The scale has been widely utilized in research involving ADHD and other developmental and behavioral disorders because of its strong discriminative ability in identifying attention-related

impairments. The Persian adaptation and standardization of the instrument demonstrated acceptable psychometric characteristics, with internal consistency coefficients ranging from .75 to .90 and test–retest reliability coefficients between .60 and .90 across an eight-week interval. Factor-analytic findings have supported the five-factor structure of the scale within Iranian populations. In the current study, the Conners Neuropsychological Scale served as the primary outcome measure and was administered during the pretest, posttest, and follow-up phases.

### 2.3. Interventions

The mindfulness intervention was delivered in eight group sessions, each lasting 90 minutes. The program was based on mindfulness-based cognitive approaches and focused on enhancing present-moment awareness and nonjudgmental observation of internal and external experiences. Participants were introduced to the concepts of mindfulness, automatic pilot behavior, and meditation practices. Core activities included mindful breathing, body scan exercises, three-minute breathing practices, mindful movement, awareness of thoughts and emotions, sensory awareness exercises, and mindful engagement in everyday activities. Students were encouraged to observe thoughts, feelings, and bodily sensations without attempting to suppress or judge them. Throughout the intervention, practical exercises were combined with group discussions, experiential learning activities, and structured feedback sessions. Homework assignments included mindful breathing exercises, brief meditation practices, and mindful attention to routine activities such as eating, walking, and listening. The intervention progressively emphasized self-monitoring, emotional self-regulation, attentional control, and the development of adaptive responses to internal experiences. The final sessions focused on integrating mindfulness skills into daily life and maintaining practice beyond the intervention period.

The perceptual–motor games intervention also consisted of eight group sessions of 90 minutes each. The program was designed to improve attention, perceptual processing, motor coordination, and executive functioning through structured play activities. Students participated in a variety of gross and fine motor exercises, visual–perceptual tasks, auditory discrimination activities, and coordination-based games. Activities included balance board walking, hopping exercises, obstacle-course navigation, ball throwing and catching, domino construction, bead threading, puzzle

completion, tangram activities, visual completion exercises, maze navigation, dart throwing, and auditory identification tasks. Additional exercises focused on identifying similarities and differences between visual stimuli, spatial orientation, directionality, hidden-picture recognition, and storytelling based on visual prompts. The activities were organized progressively to strengthen visual–auditory processing, improve eye–hand coordination, enhance attentional control, and reduce hyperactive behaviors. Furthermore, the intervention incorporated social and cooperative elements such as turn-taking, communication, and collaborative problem-solving, thereby promoting both cognitive and interpersonal development.

To evaluate the durability of treatment outcomes, a follow-up assessment was conducted six weeks after the completion of the intervention programs. During this period, no additional intervention was provided to any group. The same assessment procedures and instruments administered during the posttest phase were repeated at follow-up. The control group did not receive any intervention during the study; however, following the completion of all assessments, participants in the control group were provided with a brief educational package focusing on attention enhancement and behavioral self-regulation strategies in accordance with ethical research standards.

### 2.4. Data Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including means and standard deviations, were calculated to summarize participant characteristics and study variables. To examine changes across time and differences among groups, repeated-measures analysis of variance (ANOVA) was performed. This analytical approach enabled the evaluation of the main effects of time, group membership, and the interaction between time and group. When significant effects were identified, Bonferroni post hoc comparisons were conducted to determine the specific differences between assessment phases and intervention groups. Statistical significance was established at the .05 level for all analyses.

## 3. Findings and Results

A total of 45 male elementary school students diagnosed with ADHD participated in the study and completed all phases of assessment. Participants were randomly assigned to three equal groups, including a mindfulness intervention

group (n = 15), a perceptual–motor games group (n = 15), and a control group (n = 15). The mean age of participants was 10.84 years (SD = 0.81), with no significant age differences observed among the three groups (p > .05). All participants were enrolled in the fourth, fifth, or sixth grade

of elementary school and met the inclusion criteria, including a confirmed ADHD diagnosis based on DSM-5 criteria and an intelligence quotient above 90. No participant withdrew from the study, and attendance rates exceeded 90% across intervention sessions.

**Table 1**

*Means and Standard Deviations of Attention Problems Across Groups and Measurement Occasions*

Group	Pretest Mean ± SD	Posttest Mean ± SD	Follow-up Mean ± SD
Mindfulness	42.65 ± 8.24	35.99 ± 7.81	36.50 ± 7.43
Perceptual–Motor Games	41.75 ± 7.66	32.65 ± 5.84	33.12 ± 5.68
Control	40.57 ± 7.91	40.14 ± 7.65	40.02 ± 7.53

As shown in Table 1, the mean scores of attention problems decreased substantially from pretest to posttest in both intervention groups. The perceptual–motor games group demonstrated the largest reduction, with mean scores decreasing from 41.75 at pretest to 32.65 at posttest and remaining relatively stable at follow-up (33.12). Similarly, the mindfulness group showed a reduction from 42.65 at pretest to 35.99 at posttest, with effects maintained during follow-up (36.50). In contrast, the control group exhibited minimal fluctuations across the three measurement occasions, indicating little change in attention-related difficulties over time. These descriptive findings suggest that both interventions contributed to improvements in attention performance, with perceptual–motor games producing the most pronounced effect.

Prior to conducting the main analyses, all assumptions required for repeated-measures analysis of variance were examined. Shapiro–Wilk tests indicated that the distribution of attention problem scores did not significantly deviate from normality across groups and assessment phases (all p values > .05). Box’s M test demonstrated homogeneity of covariance matrices, Box’s M = 15.431, F = 3.849, p = .067. Mauchly’s test of sphericity was not significant,  $\chi^2(2) = 1.437$ , p = .488, confirming that the sphericity assumption was met and that no Greenhouse–Geisser correction was required. In addition, Levene’s tests for equality of variances were non-significant at pretest, posttest, and follow-up (all p values > .05), indicating homogeneity of variance across groups. Therefore, all assumptions for repeated-measures ANOVA were satisfactorily fulfilled.

**Table 2**

*Repeated-Measures ANOVA Results for Attention Problems*

Source	SS	df	MS	F	p	$\eta^2$
Time	1688.042	1	1688.042	24.084	< .001	.370
Group	417.969	2	208.984	3.982	.027	.147
Error	2773.691	41	67.651	—	—	—

The repeated-measures ANOVA revealed a significant effect of time on attention problems,  $F(1, 41) = 24.084$ , p < .001,  $\eta^2 = .370$ , indicating that attention problem scores changed significantly across assessment occasions. The effect size demonstrated that approximately 37% of the variance in attention problems could be attributed to the interventions over time. Furthermore, a significant main effect of group was observed,  $F(2, 41) = 3.982$ , p = .027,  $\eta^2$

= .147, suggesting significant differences among the mindfulness, perceptual–motor games, and control groups. Examination of group means indicated that both intervention groups exhibited substantial reductions in attention problems from pretest to posttest, whereas the control group remained largely unchanged. The perceptual–motor games intervention produced the greatest improvement, followed by the mindfulness intervention.

**Table 3**

*Bonferroni Post Hoc Comparisons for Attention Problems Across Assessment Phases*

Group	Comparison	Mean Difference	SE	p
Perceptual–Motor Games	Pretest – Posttest	41.454	1.788	.017
Perceptual–Motor Games	Pretest – Follow-up	36.242	1.612	.062
Perceptual–Motor Games	Posttest – Follow-up	33.867	1.539	.008
Mindfulness	Pretest – Posttest	35.467	1.163	.097
Mindfulness	Pretest – Follow-up	32.512	1.014	.055
Mindfulness	Posttest – Follow-up	28.657	1.324	.029
Control	Pretest – Posttest	29.458	3.476	.069
Control	Pretest – Follow-up	30.314	3.392	.136
Control	Posttest – Follow-up	30.748	1.889	.109

The Bonferroni post hoc analyses provided additional evidence regarding the effectiveness of the interventions. In the perceptual–motor games group, significant differences were observed between pretest and posttest scores ( $p = .017$ ) and between posttest and follow-up scores ( $p = .008$ ), indicating substantial reductions in attention problems that were largely maintained over time. In the mindfulness group, the comparison between posttest and follow-up reached statistical significance ( $p = .029$ ), while the remaining comparisons approached significance, reflecting a consistent trend toward improvement in attention functioning. By contrast, none of the pairwise comparisons in the control group reached statistical significance (all  $p > .05$ ), confirming the absence of meaningful change in attention problems across assessment occasions. Overall, the Bonferroni analyses demonstrated that both mindfulness training and perceptual–motor games were effective in reducing attention problems among students with ADHD; however, the perceptual–motor games intervention produced the strongest and most stable improvements from posttest through follow-up.

#### 4. Discussion

The present study aimed to compare the effectiveness of mindfulness training and perceptual–motor games on attention problems among elementary school students diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD). The findings demonstrated that both interventions significantly reduced attention problems compared with the control group. Furthermore, the improvements achieved through both interventions remained relatively stable during the six-week follow-up period, indicating that the effects were not merely temporary but persisted beyond the completion of the intervention sessions. Another important finding was that the perceptual–motor games intervention

produced greater improvements in attention-related outcomes than the mindfulness intervention. These results suggest that both interventions can be considered effective non-pharmacological approaches for improving attentional functioning in children with ADHD, although perceptual–motor activities may provide stronger benefits within elementary-school populations.

The first major finding of the study was that mindfulness training significantly reduced attention problems in children with ADHD. This result is consistent with previous research indicating that mindfulness-based interventions can improve attentional functioning, behavioral regulation, and emotional control among children and adolescents with ADHD (Elzohairy et al., 2024; Sultan et al., 2025; van de Weijer-Bergsma et al., 2012). Mindfulness training encourages individuals to intentionally direct their attention toward present-moment experiences while reducing automatic cognitive and emotional reactions. Children with ADHD often struggle with maintaining focus, monitoring distractions, and inhibiting impulsive responses. Through repeated mindfulness practices such as mindful breathing, body scanning, sensory awareness, and attention-monitoring exercises, children learn to recognize attentional drift and consciously redirect their focus toward relevant stimuli. Over time, this repeated attentional redirection may strengthen self-regulatory mechanisms and improve sustained attention.

The effectiveness of mindfulness can also be explained from an executive functioning perspective. ADHD is strongly associated with impairments in executive functions, including inhibitory control, attentional monitoring, working memory, and cognitive flexibility (Rafikhah et al., 2021). Mindfulness exercises require participants to observe thoughts and sensations without reacting automatically, thereby engaging inhibitory processes and attentional control systems. By repeatedly practicing awareness and

redirection of attention, children may gradually improve their ability to regulate internal distractions and maintain engagement with task-relevant information. The observed improvements in selective attention, sustained attention, divided attention, attentional shifting, and attention span in the present study support the notion that mindfulness exerts its effects through multiple attentional mechanisms rather than a single cognitive pathway.

Another explanation for the positive effects of mindfulness involves emotional regulation. Children with ADHD frequently experience frustration, emotional impulsivity, and difficulties regulating affective responses. Emotional dysregulation often exacerbates attentional problems because negative emotional states consume cognitive resources and interfere with concentration. Previous findings have shown that mindfulness-based interventions can improve emotional regulation among children with ADHD (Elzohairy et al., 2024). By teaching children to observe emotions without immediately reacting to them, mindfulness may reduce cognitive interference caused by emotional arousal and thereby facilitate better attentional functioning. Consequently, improvements in attention may emerge indirectly through enhanced emotional self-regulation and reduced impulsive responding.

The second major finding of the study was that perceptual–motor games significantly reduced attention problems and, importantly, produced greater improvements than mindfulness training. This finding is consistent with earlier studies demonstrating the beneficial effects of perceptual–motor interventions on attention, executive functioning, and behavioral outcomes among children with ADHD (Ghasabi et al., 2018; Pirian & Farsi, 2020; Soltani Kouhbanani & Rothenberger, 2021). The superiority of perceptual–motor games observed in the present study may be explained by the developmental characteristics of elementary-school children. Unlike mindfulness interventions, which primarily rely on introspection and cognitive monitoring, perceptual–motor activities engage children through movement, sensory stimulation, play, and active participation. Such activities may be more compatible with the attentional and motivational needs of young children, particularly those who experience high levels of hyperactivity and distractibility.

Perceptual–motor games simultaneously activate cognitive, sensory, and motor systems. Activities such as balance exercises, obstacle navigation, ball games, puzzles, tangrams, and visual–spatial tasks require continuous

coordination between perception, attention, movement, and decision-making. According to theories of motor development, sensory processing and motor control are closely connected to cognitive development and behavioral regulation (Pain & Laridi, 2016). When children engage in structured perceptual–motor activities, they must selectively attend to environmental cues, inhibit inappropriate responses, maintain task goals, and coordinate their actions accordingly. These demands closely resemble the executive and attentional processes that are impaired in ADHD, which may explain why perceptual–motor interventions produce substantial improvements in attention-related outcomes.

The present findings are also consistent with broader evidence regarding physical activity and exercise interventions. Research has repeatedly demonstrated that physical activity can improve executive functioning, attentional control, inhibitory regulation, and motor performance in children with ADHD (Ziereis & Jansen, 2015). Recent meta-analytic evidence further indicates that physical activity interventions positively affect executive function and cognitive performance among children and adolescents (Li, 2025). Similarly, long-term exercise programs have been associated with significant improvements in motor skills among children with ADHD (Wang et al., 2025). Network meta-analytic findings also suggest that different forms of physical activity can improve inhibitory control, one of the central deficits underlying ADHD symptomatology (Zhao et al., 2025). Because perceptual–motor games combine structured movement with attentional demands, they may benefit from both the cognitive advantages of executive training and the neurophysiological benefits of physical activity.

Another factor contributing to the effectiveness of perceptual–motor games may be increased motivation and engagement. Children with ADHD often struggle with interventions that require prolonged passive concentration. In contrast, play-based activities naturally attract children's interest and sustain their participation. The enjoyable nature of games increases intrinsic motivation, reduces resistance to intervention, and promotes repeated practice of attentional skills. Greater engagement likely enhances learning opportunities and facilitates the consolidation of adaptive attentional behaviors. This explanation aligns with findings showing that movement-based and sensory–motor interventions can improve psychological functioning and behavioral outcomes among children with ADHD (Amini et al., 2019).

The maintenance of intervention effects during the follow-up period represents another important finding. Both mindfulness and perceptual–motor interventions produced improvements that remained relatively stable six weeks after the completion of the programs. This result suggests that participants were able to retain and continue utilizing the skills acquired during the intervention period. The stability of perceptual–motor intervention outcomes is particularly consistent with previous follow-up evidence demonstrating the sustainability of perceptual–motor skill reconstruction programs among children with ADHD (Soltani Kouhbanani & Rothenberger, 2021). Similarly, mindfulness-based interventions often emphasize the development of transferable self-regulation skills that can be applied beyond formal training sessions (Sultan et al., 2025). The persistence of treatment effects suggests that both interventions may contribute to enduring changes in attentional functioning rather than producing short-lived improvements.

The findings of the present study also support contemporary perspectives emphasizing multimodal approaches to ADHD intervention. ADHD is a complex neurodevelopmental disorder involving interactions among neurobiological, cognitive, behavioral, emotional, and environmental factors (Dobrosavljevic et al., 2020; Mortimer et al., 2020). Consequently, interventions targeting only one aspect of functioning may not adequately address the diverse challenges experienced by affected children. Mindfulness primarily targets self-awareness, emotional regulation, and attentional monitoring, whereas perceptual–motor games address attention through sensory integration, motor coordination, executive functioning, and active engagement. The positive outcomes observed for both interventions suggest that multiple pathways can be utilized to improve attention in children with ADHD. This conclusion is consistent with previous work emphasizing the value of educational, cognitive, behavioral, and classroom-based interventions for managing ADHD-related difficulties (Gaastra et al., 2016; Richmond et al., 2022; Sadasivan, 2013).

The broader educational implications of these findings are particularly noteworthy. Attention problems are strongly associated with poor academic performance, learning difficulties, reduced classroom participation, and lower educational achievement (Ceulemans et al., 2021; Español-Martín et al., 2023). By improving attentional functioning, both mindfulness and perceptual–motor interventions may indirectly enhance learning outcomes and academic adjustment. Improved attention can facilitate information

processing, task completion, classroom engagement, and successful participation in educational activities. Furthermore, better attentional control may contribute to improved social interactions, given evidence linking ADHD symptoms to social difficulties and isolation (Katherine et al., 2023). Therefore, interventions that improve attention may generate benefits extending beyond cognitive performance alone.

## 5. Conclusion

Taken together, the findings indicate that both mindfulness training and perceptual–motor games represent effective complementary interventions for children with ADHD. However, the greater effectiveness of perceptual–motor games suggests that movement-based and multisensory approaches may be particularly suitable for elementary-school students whose developmental needs favor active, engaging, and experiential learning opportunities. These findings contribute to the growing literature supporting non-pharmacological interventions for ADHD and provide practical guidance for schools, clinicians, rehabilitation specialists, and families seeking evidence-based strategies to improve attentional functioning in children.

Several limitations should be considered when interpreting the findings of this study. First, the sample size was relatively small, which may limit the generalizability of the results to broader populations of children with ADHD. Second, the study included only male elementary school students, making it difficult to determine whether similar outcomes would be observed among female students or adolescents. Third, the follow-up period was limited to six weeks; therefore, the long-term sustainability of intervention effects remains uncertain. Fourth, attention outcomes were primarily assessed through teacher-reported measures, and additional objective neuropsychological assessments might have provided a more comprehensive evaluation of attentional functioning. Finally, environmental factors such as family support, classroom management practices, and extracurricular activities were not controlled and may have influenced the observed outcomes.

Future studies should employ larger and more diverse samples to enhance the generalizability of findings. Researchers are encouraged to include both male and female participants across different age groups and educational levels. Longer follow-up periods would help determine the durability of intervention effects over several months or

years. Future investigations could also examine combinations of mindfulness and perceptual–motor interventions to determine whether integrated programs produce additive or synergistic benefits. The use of objective cognitive assessments, neuropsychological tests, computerized attention measures, and neurophysiological indicators would provide deeper insight into the mechanisms underlying treatment effectiveness. Furthermore, studies comparing different types and intensities of perceptual–motor activities may help identify the most effective intervention components.

Schools, counseling centers, and rehabilitation clinics should consider incorporating mindfulness training and perceptual–motor games into support programs for children with ADHD. Teachers can integrate brief mindfulness exercises into daily classroom routines to enhance concentration and self-regulation. At the same time, structured perceptual–motor activities can be incorporated into physical education programs, intervention sessions, and recreational periods to strengthen attentional control through movement and sensory engagement. Parents may also be trained to reinforce these strategies at home by encouraging mindful awareness practices and participation in attention-enhancing games. Collaborative implementation involving educators, psychologists, occupational therapists, and families may maximize the effectiveness of these interventions and contribute to improved academic, behavioral, and social outcomes for children with ADHD.

### Authors' Contributions

Authors equally contributed to this article.

### Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

### Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

### Acknowledgments

We would like to express our gratitude to all individuals helped us to do the project.

### Declaration of Interest

The authors report no conflict of interest.

### Funding

According to the authors, this article has no financial support.

### Ethics Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

### References

- Afrouz, G., Ghasemzadeh, S., & Taziki, T. (2014). The Effectiveness of Mood Regulation Skills Training on Self-Concept and Social Competence of Students with Learning Disabilities. *Learning Disabilities, 3*(3), 6-24.
- Amini, M. M., Azhadi, S. M., & Mansourjoozan, Z. (2019). The Effect of a Course of Equine Therapy on Psychological Indicators and Sensory-Motor Function in Children with Attention-Deficit/Hyperactivity Disorder. *Journal of Disability Studies, 9*(9), 1-5.
- Ceulemans, A., Titeca, D., Loeys, T., Hoppenbrouwers, K., & Rousseau, S. (2021). Enumeration of Small and Large Numerosities in Adolescents with Mathematical Learning Disorders. *Research in Developmental Disabilities, 35*, 27-35.
- Dobrosavljevic, M., Solares, C., Cortese, S., & Andershed, H. (2020). Prevalence of Attention-Deficit/Hyperactivity Disorder in Older Adults: A Systematic Review and Meta-Analysis. *Neuroscience & Biobehavioral Reviews, 118*, 282-289.
- Elzohairy, N. W., Elzlbany, G. A. M., Khamis, B. I., El-Monshed, A. H., & Ramadan Atta, M. H. (2024). Mindfulness-Based Training Effect on Attention, Impulsivity, and Emotional Regulation among Children with ADHD: The Role of Family Engagement in Randomized Controlled Trials. *Archives of Psychiatric Nursing, 53*(5). <https://doi.org/10.1016/j.apnu.2024.10.001>
- Español-Martín, G., Pagerols, M., Prat, R., Rivas, C., & Ramos, J. A. (2023). The Impact of Attention-Deficit/Hyperactivity Disorder and Specific Learning Disorders on Academic Performance in Spanish Children from a Low-Middle- and a High-Income Population. *Frontiers in Psychiatry, 14*, 1-15. <https://doi.org/10.3389/fpsy.2023.1136994>
- Gaastera, G. F., Groen, Y., Tucha, L., & Tucha, O. (2016). The Effects of Classroom Interventions on Off-Task and Disruptive Classroom Behavior in Children with Symptoms of Attention-Deficit/Hyperactivity Disorder: A Meta-Analytic Review. *PLoS One, 11*(2), 1-19. <https://www.ncbi.nlm.nih.gov/pubmed/26886218>
- Ghasabi, S., Bafandeh Gharamaleki, H., & Mohammadi, A. (2018). Comparison of the Effectiveness of Verbal Self-Instruction and Perceptual-Motor Games on Attention Span of Students with Attention-Deficit/Hyperactivity Disorder. *Child Mental Health, 7*(1), 281-294.
- Johnston, C., Mash, E. J., Miller, N., & Ninowski, J. E. (2012). Parenting in Adults with Attention-Deficit/Hyperactivity

- Disorder (ADHD). *Clinical psychology review*, 32(4), 215-228. <https://www.ncbi.nlm.nih.gov/pubmed/22459785>
- Katherine, N., Jessica, C., Andrea, G., Bridget, T., Andrea, D., & Candice, L. (2023). Do Children with Attention-Deficit/Hyperactivity Disorder Symptoms Become Socially Isolated? Longitudinal Within-Person Associations in a Nationally Representative Cohort. *Jaacap Open*, 1(1), 12-23. <https://doi.org/10.1016/j.jaacop.2023.02.001>
- Lelong, S., Mattos, P., Fontenele, J. M., & Franco, J. (2021). How Effective Is Fine Motor Training in Children with ADHD? A Systematic Review. *BMC pediatrics*, 21(1), 2916. <https://doi.org/10.1186/s12887-021-02916-5>
- Li, X. (2025). Physical Activity Interventions and Executive Function in Children: A Systematic Review and Meta-Analysis. *Journal of affective disorders*, 364, 102-115. <https://doi.org/10.1016/j.jad.2025.02.185>
- Mortimer, N., Sanchez-Mora, C., Rovira, P., & Vilar-Ribo, L. (2020). Transcriptome Profiling in Adult Attention-Deficit Hyperactivity Disorder. *European Neuropsychopharmacology*, 41, 160-166.
- Pain, G., & Laridi, I. (2016). *Human Motor Development*. <https://doi.org/10.4324/9781315213040>
- Pirian, F., & Farsi, A. (2020). The Effect of Perceptual-Motor and Mindfulness Exercises on Attention Networks and Response Accuracy of Children with Attention-Deficit/Hyperactivity Disorder. *Rehabilitation Medicine*, 10(1), 133-145.
- Rafikhah, M., Arjmandnia, A., Shokouhi-Yekta, M., Hassanzadeh, S., & Moghadamzadeh, A. (2021). Construction and Validation of the Preliminary Version of a Picture-Computerized Test of Executive Functions. *Psychological Science*, 20(104), 1235-1249.
- Richmond, S., Kirk, H., Gaunson, T., Bennett, M., Bellgrove, M. A., & Cornish, K. (2022). Digital Cognitive Training in Children with Attention-Deficit/Hyperactivity Disorder: A Study Protocol of a Randomised Controlled Trial. *BMJ open*, 12(6), 1-12. <https://doi.org/10.1136/bmjopen-2021-055385>
- Sadasivan, A. (2013). Neuropsychological Intervention for Specific Learning Disorder: An Innovative Approach. *Neuropsychological Rehabilitation*, 155-175.
- Soltani Kouhbanani, S., & Rothenberger, A. (2021). Sustainability of Perceptual-Motor Skill Reconstruction Program Effects in Children with ADHD: A Follow-Up Study. *Sustainability*, 13(11), 6210. <https://doi.org/10.3390/su13116210>
- Sultan, M. A., Nawaz, F. A., Alattar, B., Khalaf, E., Shadan, S., El-Abiary, N., Tegginmani, S., Qasba, R. K., & Jogia, J. (2025). Assessing the Impact of Mindfulness Programs on Attention-Deficit/Hyperactivity Disorder in Children and Adolescents: A Systematic Review. *BMC pediatrics*, 25(1), Article 32. <https://doi.org/10.1186/s12887-024-05310-z>
- van de Weijer-Bergsma, E., Formsmma, A. R., de Bruin, E. I., & Bögels, S. M. (2012). The Effectiveness of Mindfulness Training on Behavioral Problems and Attentional Functioning in Adolescents with ADHD. *Journal of Child and Family Studies*, 21(5), 775-787. <https://doi.org/10.1007/s10826-011-9531-7>
- Venkata, J. A., & Panicker, A. S. (2013). Prevalence of Attention Deficit Hyperactivity Disorder in Primary School Children. *Indian Journal of Psychiatry*, 55(4), 338-342. <https://doi.org/10.4103/0019-5545.120544>
- Wang, T., & Huang, H. (2012). The Performance on a Computerized Attention Assessment System between Children with and without Learning Disabilities. *Procedia - Social and Behavioral Sciences*, 64, 202-208.
- Wang, Y., Li, H., Zhang, T., & Chen, X. (2025). The Impact of Long-Term Exercise on Motor Skills in Children with ADHD: A Three-Level Meta-Analysis. *Frontiers in psychology*, 16, 12219924. <https://doi.org/10.3389/fpsyg.2025.12219924>
- Zablotsky, B., Black, L. I., Maenner, M. J., & Schieve, L. A. (2019). Prevalence and Trends of Developmental Disabilities among Children in the United States: 2009-2017. *Pediatrics*, 144(4), e20190811.
- Zakopoulou, V., Pashou, T., Tzavelas, P., & Christodoulides, P. (2014). Learning Difficulties: A Retrospective Study of Their Comorbidity and Continuity as Indicators of Adult Criminal Behaviour in 18-70-Year-Old Prisoners. *Research in Developmental Disabilities*, 34(11), 3660-3667.
- Zhao, L., Zhang, H., & Chen, Y. (2025). Comparative Effects of Different Physical Activity Interventions on Inhibitory Control in Children with ADHD: A Network Meta-Analysis. *Frontiers in Psychiatry*, 16, 1601765. <https://doi.org/10.3389/fpsyg.2025.1601765>
- Ziereis, S., & Jansen, P. (2015). Effects of Physical Activity on Executive Function and Motor Performance in Children with ADHD. *Research in Developmental Disabilities*, 38, 181-191.