



## Physical Activity based Interventions for Treating Learning related Disorders among Children: A Systematic Review Study

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**DOI:10.48047/ecb/2023.12.si4.695**

### Abstract

**Background:** The evidence supports the beneficial effects of physical activity on focusing and sustained attention, concentration, learning activities, cognitive performance, and memory, and suggests that the effects could be especially significant in children to perform better in their academic success. However, limited research has explored in regard to physical activity as a way to manage behavioral symptoms and improve cognitive-related performance among children with learning-related disabilities including attention deficit hyperactivity disorder (ADHD).

**Objective:** The purpose of this systematic review article is to review the literature concerning the potential of physical activity for the management of symptoms of learning disabilities, ADHD, and other child-related behavioral issues.

**Methods:** An extensive search was conducted through major databases for studies published between 1990 and January 31, 2023, in Google scholar, Scopus, Web of Science core collection, PubMed, PsycINFO, Embase, ISI, and the Cochrane Library, based on the selection criteria.

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**Results:** The results revealed that the outcomes of various interventional activities related to physical activity are discussed in detail. Thirteen articles were included in the final review. Due to the variety of methodological approaches, sample size, test estimate, and most critically, the intervention duration, the framework of physical activities, and tests used to measure symptoms, it is troublesome to recognize the best approach of physical activity to intervene in symptoms related to learning related disorders and ADHD. However, it is plausible to argue that physical activity interventions can provide an alternative, non-pharmaceutical approach to the management of learning disorders, especially conduct disorders and ADHD in children.

**Conclusion:** Integrated approach with yoga interventions, mindfulness-based meditation, and aerobic exercises are promising interventional tools for enhancing the motor, attention, imitation skills, and cognitive-related symptoms of children with learning-related disorders.

**Keywords:** *Physical activity, Yoga, Mindfulness, Cognitive performance, Children*

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## **Introduction**

Educators tend to focus on improving academic achievement, behavioural outcomes, smooth peer group relationships, and enhance self-esteem among children with learning disabilities (LD), especially dyslexic and attention deficit hyperactivity disorder (ADHD) children (Kowalski et al., 2014; Pascoe et al., 2020). Recently, interest has developed on implementing physical activity and exercise-based interventions as potential for the multidisciplinary treatment of children with learning disabilities (Efstratopoulou et al., 2012; Estrada-Plana et al., 2019). The range of physical activity and exercises varies and also found some shreds of evidences to suggest that acute aerobic exercise has beneficial effects on various executive functions. Regular aerobic training may also confer chronic benefits for executive functions, attention, and behavior. Worldwide, various preliminary research support has grown further indicated that non-aerobic exercise such as yoga, may also be associated with both acute and chronic improvements in the core symptoms of learning disabilities, attention, focused attention, and reduce ADHD symptoms specifically, inattentive and hyperactivity symptoms. Meanwhile, physical activity interventions offer promising outcomes among children with ADHD to reduce dropouts in school and can impede real-world implementation of interventions (Bluehardt et al., 1995; Howie & Pate, 2012; Vancampfort et al., 2016).

There are interventions identified in the literature to address the challenges faced by children with attention issues. They include behavioral and cognitive treatments for children who have received a diagnosis of learning difficulties. Behavioral interventions, such as token reinforcement programs, contingency contracting, and response cost, are commonly used with children and be effective in improving classroom behavior because of providing immediate feedback and incorporating secondary reinforcements. Although medications have negative side effects for children (e.g., insomnia, appetite loss), research evidenced that have a positive effect on classroom behavior, social interactions, and academic performance.

Followed by yoga is another promising alternative intervention for a variety of social, emotional, behavioral, and academic improvement. Experimental research evidenced that

yoga is one of the effective methods to improve attention-related issues and oppositional behavioral issues, which helps to reduce inattention, hyperactivity, and anxiety and improved children's peer group relationships and sleep quality. Because of incorporating various physical activities in yoga practice such as physical postures, breath control, mental concentration, and deep relaxation, helps more in decreasing ADHD symptoms in children like hyperactivity, impulsivity, and inattention(Jensen & Kenny, 2004).Yoga also tends to promote self-control, attention and concentration, self-efficacy, body awareness, and stress reduction (Kuppili et al., 2017; Mak et al., 2018; Rogers & Fedewa, 2016). The coordination of body movements and stretching in combination with deep breathing improves the body's overall circulation.

The traditions of yoga and mindfulness are two distinct yet interconnected practices focused on the well-being of children. Mindfulness-based mediation comprises directing attention to present thoughts, emotions, or bodily sensations such as movement of body parts, oxygen movement while breathing in and out, recognizing familiar objects through touching physically without seeing, and more. Multiple studies revealed that mindfulness-based meditation evidenced that positive effect on the both physical and mental health of children. Mindfulness approaches have also been evidenced to be effective with children in deals with improving executive functions, attention, self-regulation, and academic performance, reduce stress and social involvement(Karim & Venkatachalam, 2020; Ortega et al., 2007; Park et al., 2019; Sit et al., 2019). To reduce behavioral issues and improve academic performance, the first most things that should be done are to determine the potential interventions utilized for children with learning-related disabilities. Also, to determine related symptoms and plan effective interventions, it is significant to know the studies that have been conducted with children previously, particularly in the most recent days. Thus, a systematic review has been conducted to specify studies that were conducted with children with learning disabilities, ADHD, or other attention-related issues that are highly related to academic performance in India and globally, and also to determine the factors related to developing such symptoms.

## **Material and methods**

### **Design**

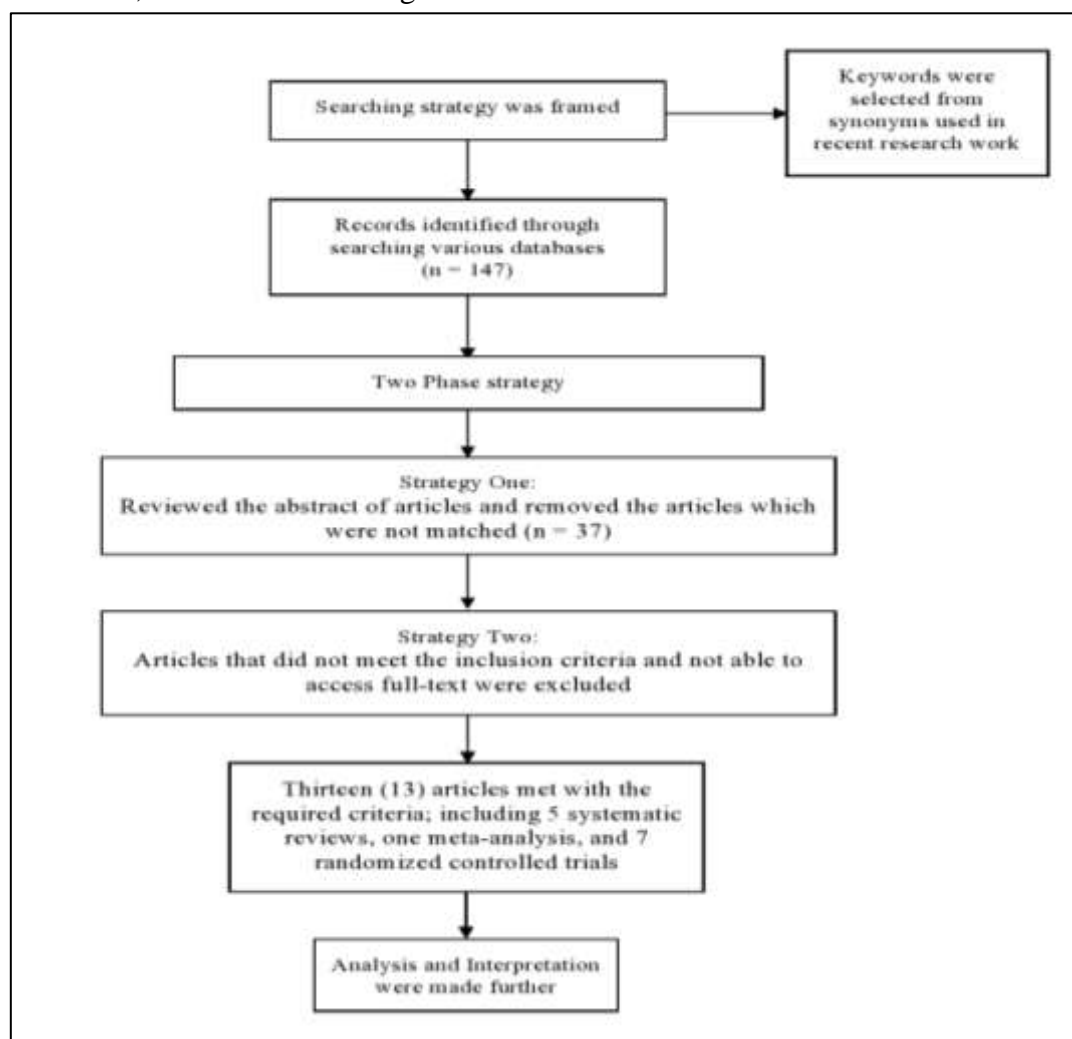
The researcher followed guidelines on methodology of reviews(Roe, 2007), as well as Cochrane Handbook guidelines (Higgins et al., 2019).

### **Search strategy and selection criteria**

Electronic databases such as Google scholar, Scopus, Web of Science core collection, PubMed, PsycInfo, Embase, ISI, and the Cochrane Library were searched with time limit between 1990 and January 31<sup>st</sup>2023 as well as limits with English language only. It also categorized into two such as India and rest of the world. The search terms in databases were “children with learning disabilities”, “learning disorders”, “inattention”, “hyperactivity”, “intervention”, “physical activity”, and “impulsivity”. One and the combination of 7 keywords was used as searching strategy in this review article. Further, all the articles which were come under the inclusion criteria were examined and reviewed. The PRISMA flow chart (Figure 1) explore more about the methodological process of this study.

### Inclusion and exclusion criteria

In the present study has been followed carefully about the following inclusion criteria: (1) have published between 1990 and January 31<sup>st</sup>2023, (2) has been published in English, (3) participants must be children with issues that affect academic performance, (4) subject of the studies must be implementing intervention with children, (5) only experimental or quasi-experimental, randomized controlled trial, previous systematic reviews with children intervention related to physical activity such as yoga or mindfulness, exercises, motor control aerobic exercises, and meta-analysis studies related to the effect of intervention deals with children issues, were considered eligible.



**Figure 1:** PRISMA Flow chart of the present study

The following exclusion criteria have been adopted in this study: (1) children with chronic psychiatric illness other than ADHD and Learning disabilities, (2) psychometric studies on developing child-related scales or tests, (3) studies lacking full text accessibility, (4) descriptive, observational studies including prospective or retrospective cohort study, case-control study, cross-sectional study, were excluded from the present review study.

### Search results

While entered the keywords into databases, one hundred forty seven (147) studies were found and the selected articles were reviewed under two phases. In the first phase,

researcher reviewed the abstract of articles and removed the articles which were not matched in the inclusion criteria. At the end of the first phase, researcher finalized 37 studies. Further, in the second phase, researcher read the full-texts of selected articles and those articles that did not meet the inclusion criteria (not access full-text) were excluded again. Hence, finally, 13 articles only met with the required criteria which include 5systematic reviews, one meta-analysis, and 7randomized controlled trials. Such articles have been selected for further research process. All the selected articles have been published in English language which was listed in Table 1.

**Table 1:**

Author(s)	Purpose	Sample size / Studies included	Data collection methods	Research Design	Instruments used	Outcomes
Chimiklis et al., (2018)	To identify the efficacy of intervention programs for the treatment of children with ADHD	13	Databases	Systematic review and Meta-analysis	Used Instruments of ADHD symptoms, Hyperactivity, Executive function, parenting Stress (Parent form, Teachers form)	Poor methodology and high risk of bias across studies make it difficult to confirm whether yoga, mindfulness, and meditation are clinically efficacious. Comparison of yoga, mindfulness, and meditation relative to other evidence-based treatment modalities for ADHD (medication and/or behavioural interventions), within the context of rigorously designed RCTs, would be needed to fully appreciate the potential of these approaches for ADHD in children.
Cohen et al., (2018)	To explore the efficacy of practicing yoga for 6 weeks on behavioural symptoms, attentional control, and Heart rate variability (HRV).	23	Self-reported scales	Mixed-methods randomized waitlist controlled trial design	Parent and Teacher Rating Scales KiTAP Test of Attentional Performance for Children Heart Rate Variability Yoga Instructor Ratings Satisfaction and Perception Questionnaires Yoga Frequency	Yogapractice improves parent ratings of inattention and combined symptoms for a subset of children with higher ADHD symptoms at baseline, but not for the group overall, or for teacher ratings. The researcher indicated that yoga may be considered an additional intervention to improve attention.

Rezaei et al., (2018)	To evaluate effects of Neuro-feedback (NFB) and yoga based exercise intervention on sustained attention in children with ADHD.	21	Database Search	Three-way parallel group RCT design	Continues Performance Test (CPT)	Neuro-feedback and yoga could improve some attention variables but in terms of comparison, neuro-feedback practices seem to lead to better and wider progress in some of the variables.
					Wechsler Intelligence Scale for Children-Revised	
Biddle et al., (2019)	To concern physical activity and mental health in children, and to judge the extent to which associations can be considered causal.	42	Databases	Systematic review and Meta-analysis(Qualitative content analysis)	Instruments used to measure outcomes such as depression, anxiety, self-esteem, cognitive functioning	An extensive analysis of a large number of systematic reviews, that physical activity is associated with mental health in young people. A causal association can be claimed for cognitive functioning, in part for depression, but not currently for self-esteem.
Mak et al., (2018)	To evaluate the efficacy of mindfulness-based interventions including mindful movements such as yoga on attention and executive function in children	13	Database Search	Systematic Review	Used Instruments such asCochrane Collaboration's tool	The effects of mindfulness-based interventions on attention and Executive Function in children cannot be clearly concluded from the current literature.However, there researcher indicating that the need for future research.
Chou & Huang, (2017)	To examine yoga exercise intervention influenced the sustained attention and discrimination function in children with ADHD	49	Self-report	Non-randomized with controlled trial	Visual Pursuit Test	Yoga exercise can be utilized as an alternative treatment for children with ADHD to reduce attention and inhibition problems.
					Determination Test	
					Physical fitness	

Sánchez-López et al., (2015)	To explore a two-year multidimensional preschool intervention (Movi-Kids) aimed to improving academic achievement in children with or without attention deficit hyperactivity disorder	21 schools	Interventional randomized cluster trial	Randomized cluster trial	Anthropometry and body composition	A panel of experts has recommended that policies be implemented to increase physical activity in children through school-based initiatives.
					Academic achievement	
					Attention deficit hyperactivity disorder risk	
					Motor skills	
					Health-related quality of life (Kiddy-Kindl Questionnaire)	
Children's Sleep Habits Questionnaire						
Hariprasad et al., (2013)	To study the effects of yoga as a complementary therapy in children with ADHD	9	Self-report	Open-label exploratory study	Conners' abbreviated rating scale, ADHD-rating scale-IV, Clinical global impression (CGI)-Severity	Yoga training for therapy is feasible and can be used as an add-on therapy for ADHD
Garg et al., (2013)	To examine the effectiveness of the Get Ready to Learn (GRTL) program in	51	Self-report	Pretest-posttest design	GRTL Data sheet	Significant improvement was collectively seen on all four behaviours when the program was implemented for 16 to 19 weeks.
					Independence	
					Transition	



	improving classroom behaviours of elementary students with disabilities.				Self-regulation	
Rivilis et al., (2011)	To synthesize the recent available data on fitness and physical activity in children with DCD(To identify relevant studies reporting on physical activity and/or fitness in children with motor coordination difficulties)	40	Database Search	Systematic Review	Instruments used to measure outcomes motor proficiency, fitness and physical activity, developmental coordination disorder, motor skills disorder, coordination disorder	Motor competence plays an important part in fitness and physical activity outcomes. It has been clearly demonstrated that body composition, cardiorespiratory fitness, muscle strength and endurance, aerobic capacity, power, and physical activity have all been negatively associated with poor motor proficiency.

Smith et al., (2013)	To pilot a before-school physical activity intervention for reducing ADHD symptoms in young children.	17	Self-report (Parent form)	Pre-Post design	Disruptive Behaviour Disorders Rating Scale, Bruininks–Oseretsky Test of Motor Proficiency, 2nd edition (BOT-2), Motor timing task, Shape School, Sentence Memory	Physical activity shows promise for addressing ADHD symptoms in young children.
Biddle & Asare, (2011)	To synthesise reviews investigating physical activity and depression, anxiety, self-esteem and cognitive functioning in children and adolescents and to assess the association between sedentary behaviour and mental health	27	Database Search	Systematic Review	Instruments used to measure outcomes mental health outcome variables such as depression, anxiety, self-esteem, cognitive functioning	Physical activity and mental health in young people is likely to have positive psychosocial outcomes. The effects seem strongest for self-esteem and those who are physically active seem less likely to suffer from mental health problems and may have enhanced cognitive functioning.

Bluechardt et al., (1995)	To examines interactions between motor proficiency, self-worth and social behaviour in children with learning disabilities, focusing upon the possible therapeutic value of physical activity programmes with an embedded component of social skills training and problem-solving	24	Database Search	Systematic Review	Instruments used to measure outcomes such as Bruininks-Oseretsky Test of motor proficiency, The Body Coordination Test, Devereux Test of Extremity Coordination, American Association of Health Physical Education and Recreation (AAHPER) Test	A structured physical activity programme with a low student:instructor ratio is an effective way of improving both actual physical ability and perceived athletic, social and academic competence in students with learning disability.
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## **Discussion**

This systematic review was conducted through the literature on physical activity for the management of symptoms of learning disabilities, ADHD, and other child-related behavioral issues. For that 13 studies were finally selected through a systematic process, within that, 5 were from systematic reviews, one meta-analysis, and 7 as randomized controlled trials. The mindfulness-based interventions and yoga-based interventions predominantly demonstrated efficacy in improving aspects of child attention, learning, hyperactivity, and executive function outcomes, with the efficacy independently confirmed by calculated effect sizes (Hands & Larkin, 2006; Karim & Venkatachalam, 2020; Pontifex et al., 2014). Overall, the efficacy of yoga practices and mindfulness-based interventions for enhancing attention in children is to be established (Cohen et al., 2018). The results to date are promising, especially with a systematic literature review showing the efficacy of yoga and mindfulness practices in enhancing attention, concentration, hyperactivity, and impulsivity in children with learning disabilities and children with or without ADHD (Cook et al., 2015; Estrada-Plana et al., 2019; Kuthalingam et al., 2022; Peijnenborgh et al., 2016). Further high-quality research in children is needed to examine more in-depth.

The overall findings showed that a positive effect in regard to physical activity in any way is increased cognitive function and academic achievement in children with learning difficulties (Garg et al., 2013). Almost all studies in the past two decades have had at least some positive finding, however, need further exploration is warranted. The most consistent positive effect or findings, and most commonly-measured outcome, have been with executive functions, particularly inhibition (Karim & Venkatachalam, 2018), hyperactivity, impulsivity, inattention, and working memory (Biddle et al., 2019; Biddle & Asare, 2011). Executive functions are highly predictive of academic achievement with early assessments of executive functions predicting later academic success with children. In addition, executive function deficiencies have been researched extensively concerning learning disabilities, including ADHD, and children with learning disabilities have impaired executive functions. Recent research studies in India have evidenced that yoga-based physical activities highly increase fitness and also increase academic achievement (Hariprasad et al., 2013; Kuppili et al., 2017; Nangia & Malhotra, 2012). However, the need to be more explored in this area is warranted and some studies also pointed out to be premature saying the effect of yoga practices on children with learning difficulties could get beneficial through very short interventions.

Interestingly, Mindfulness-based training in the existing literature consists of body awareness training where the participants focus internally on their own bodily sensations and state. However, the majority of the attention outcomes reviewed in this paper consisted of monitoring how well participants attend to external stimuli not measuring through internally. Improvements in attending to internal bodily states would be difficult to observe by another person so these measures too are measures of attention to external stimuli, not internal ones. Hence, further studies could be warranted on this aspect to determine or examine participants' physiological responses (e.g., EEG) while they perform a mindfulness practice observing their breath (Chimiklis et al., 2018; Evans et al., 2018; Herbert & Esparham, 2017).

This review has several limitations. To increase the breadth, the review included a wide range of published intervention studies and review studies on physical activity and academics with less rigorous exclusion criteria than cohort or other observational studies. Only studies published in peer-reviewed journals were included but not including dissertations or theses. Also, not included the effect of physical activity-related interventions with autistic children or any other severe psychiatric illness.

## **Conclusion**

This systematic review study was conducted to determine the interventions utilized with children with learning difficulties as well as children with ADHD. It was found that the majority of the studies were carried out with yoga-based intervention and mindfulness-based intervention and few were review studies in the recent past. Overall, the yoga and mindfulness-based interventions were more effective in implementing with children for improving various outcomes, including attention, concentration, hyperactivity, executive functions, impulsivity, and working memory. No qualitative based studies were found in this domain. Yoga-based studies were carried out in more numbers in the Indian context and need to be further evidence with longitudinal studies about the effectiveness is warranted in the future. Furthermore, interventional studies incorporating multiple physical activity-based interventions utilized in a study are more demand to know the effectiveness of the intervention. Further high-quality studies focusing on standardized mindfulness-based interventions and using standardized attention measures are needed.

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