

Nonpharmacological Interventions for Children with Attention Deficit Hyperactivity Disorder in India: A Comprehensive and Comparative Research Update

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ABSTRACT

The nonpharmacological treatments for children with attention deficit hyperactivity disorder (ADHD) have witnessed a sea change from a rudimentary and haphazard psychosocial to cognitive interventions to social and behavioral skills to body oriented interventions to more sophisticated neurocognitive interventions. As the objective of each treatment varied, the method or procedure of each treatment also differed across studies. Indian research although not very rigorous, did witness changes emphasizing on exploring interventions in reducing symptoms and improving overall behavior. The research literature between 2005 and 2015 was searched using PubMed, Google Scholar, IndMED, MedIND, ResearchGate, and other indexed databases. Results of 110 studies were organized into five broad categories of themes of interventions such as psychosocial, body-focused, cognitive/neuro-cognitive, and cognitive behavioral. Effects of ADHD on cognitive, academic, and behavioral outcomes were also highlighted before the themes of intervention to establish linkage with discussion. However, a limited number ($n = 9$) of reported Indian studies focusing either on the impact of ADHD on the function of children or on interventions were found, suggesting a huge gap between global and Indian research in the area of children with ADHD. It also highlights the need for development and efficacy testing of indigenous intervention program in different areas of intervention for research and clinical practice.

Key words: Attention deficit hyperactivity disorder, children, Indian research, nonpharmacological interventions

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental,^[1] sociobehavioral, and cognitive disorder characterized by developmentally inappropriate levels of inattention, impulsivity, and hyperactivity often persist into adulthood.^[2] Its clinical complexity and

heterogeneity^[3] resulted in largest referrals in mental health, educational, and medical settings^[4] in past. ADHD results in poor performance of vigilance, working memory, sustained attention, planning, and executive functions.^[5,6]

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The nonpharmacological treatments in 1980s focused on cognitive training (CT) program containing self-instructional and self-management skills for improvement in classroom behavior and academics.^[7] Studies in 1990s reported more advantages of behavior modification strategies than cognitive or cognitive-behavioral approaches to behavior management. Classroom-based interventions such as instructional materials,^[8] behavior management and cognitive-behavioral therapy,^[9] self-management strategies,^[10-12] reinforcement-based attention training system,^[13,14] and ADHD classroom-wide kit^[15] were also advocated.

The outcomes variables in 2000s shifted from behavioral improvements to reduction in cognitive deficits^[16-19] and also witnessed effects of interventions on parenting skills training, social skills, and problem-solving training.^[20] Systematic reviews (between-group, within-subject, and single-subject study designs) synthesized the behavioral treatments and reported moderate to sustainable development for disruptive behaviors.^[21-23]

The paper provides a review of key nonpharmacological interventions and identifies gaps/emerging needs.

MATERIALS AND METHODS

The search period was from January 1, 2005, to August 31, 2015. The electronic databases were PubMed, Google Scholar, IndMED, MedIND, and ResearchGate. Seven levels of screening had different search parameters with specific inclusion and exclusion criteria. From screening level III onward papers were included based on a review of the title, abstract, and reference. The key word ADHD was combined separately with psychosocial, cognitive, and behavioral intervention; nonmedical/nonpharmacological treatment; parents/peer relationship/friendship training; mindfulness-based-interventions; social skills training; school/home-based intervention; neurofeedback (NF)/computer training; physical exercises; play and music therapy; classroom-based therapy; mindfulness-training; working memory; and attention training. Specific print journals not continuously indexed from 2005 to 2015 (e.g., Indian Journal of Psychological Medicine, Journal of Psychological Research, Indian Pediatrics, Indian Psychological Review, and Indian Journal of Clinical Psychology) were included. About 256,019 hits/citations were generated for screening. The full texts of 46 papers were analyzed. Although five Indian studies met inclusion criteria, all nine were included to expand discussion. Table 1 presents the literature search summary.

RESULT

Studies with similar objectives, content, intervention technique, and type- or theme-focused interventions were grouped into one category. Four categories of intervention were formed as follows:

- Psychosocial interventions: (Behavioral intervention, parent training, peer relationship training, social skills training, and school/classroom-based intervention/training)
- Body-focused interventions: (Body-oriented/yoga-based/physical exercise/sleep intervention/mindfulness-based interventions [MBIs])
- Cognitive/neuro-CT: CT/computer attention training/working-memory training/attention training/NF training/BMG biofeedback intervention
- Cognitive-behavioral interventions: (play-therapy and cognitive-behavior therapy).

Tables 2-5 present summary of results.

DISCUSSION

Key thematic areas discussed were the type of intervention, characteristics of intervention, issues and emerging trends in intervention, gaps between global and Indian studies, and needs.

Type of intervention

Psychosocial interventions

There are two categories: The packaged one with better structured contents and definite methodology of implementation (e.g., parent training programs such as the new forest parent training program [NFPP], the triple P-positive parenting program, and the incredible years [IY]; social and relationship skills program such as Program for the Evaluation and Enrichment of Relational Skills)^[29,33] and another is less well-defined/nonpackaged intervention programs with less structured detailing of content and methodology of implementation (e.g., parent behavioral training, behavioral classroom intervention, academic intervention, summer treatment program, social skill training, parent-assisted, and friendship-building program). Although, their effects are highly dependent on the context as moderating variables affecting interventions.^[70] Indian control trial by Rejani *et al.*^[32] reporting the efficacy of multimodal treatment did not meet inclusion criteria. The packaged intervention programs have better scope for replication, modification, and adaptation.

In India, a qualitative study in Goa, India^[71] reported that parental perception and behavior toward ADHD

Table 1: Literature search

Screening/ filtration level	Selection- parameters	Inclusion	Exclusion	Number of hits/studies	Results
Prescreening	ADHD	Psychiatric diagnosis of ADHD symptoms only	No applied	256,019 hits (PubMed=46,290, IndMED=30, MedIND=7, ResearchGate=13, and Google Scholar=209,800)	256,019 citations for screening
I	Population	<18 years; IQ=normal average	Adult cases; IQ below normal average	42,034 (PubMed=20,774, IndMED=13, MedIND=2, ResearchGate=11, and Google Scholar=21,234)	42,034
II	Period	1 st January 2005 to 31 st August 2015	Publication before and after		
III	Type of intervention/ focus of study	Interventions for 3 weeks	Interventions <3 weeks, CAM, and multimodal treatments	3860 (PubMed=3590, IndMED=13, MedIND=2; ResearchGate=11, and Google Scholar=244)	3860
IV	Comorbidity	No comorbidity	ODD, SLD, conduct disorder, low working memory in absence of ADHD, Tourette syndrome, psychiatric illness, severe mood dysregulation, chronic physical illness or traumatic brain injury, and children at risk of ADHD	270 (PubMed=224, IndMED=5, MedIND=1, ResearchGate=7, and Google Scholar=33)	270
V	Study designs	Meta-analyses, randomized-controlled, quasi-randomized, uncontrolled, and pilot studies, review articles and case reports	Theoretical and opinion-base studies; and studies without pre- and post-symptom assessment	138	138
VI	Full-length papers	Full-length papers; in English	Elaborated abstracts; non-English papers	110	110
VII	Others	Not specific	Papers in duplicate, single case report, and case series, high cost of full paper	46 included as global literature	46
VIII	Indian papers: Same parameters till filtration level-VII	Indian residential status	Indian children residing outside India or Indian Americans or any other such type	Of 28, 5 met all inclusion criteria and 9 studies included	9

CAM – Complementary and alternate medicine; ADHD – Attention deficit hyperactivity disorder; SLD – Specific learning disorder; ODD – Oppositional defiant disorder

treatment choice are significantly affected by cultural attitudes toward mental illness as often parents attribute the behavior to learning and memory difficulties, educational problems than considering ADHD as a mental health problem. However, intervention program on peer relationship or social-skills training is not reported in the past years, except few highlighting the importance of psychoeducational interventions at school^[26] and understanding cultural dimensions and teacher's perspectives of learning problems in the classroom.^[72]

Indian research indicates the need for testing the feasibility, effectiveness, and efficacy of these packaged programs. This calls for more rigorous research attempts for culture specific efficacious psychosocial intervention.

Body-focused interventions

Existing Indian studies^[46,73] were primarily on yoga and meditation and other forms of breathing exercises to improve attention, cognitive functioning, and other behaviors. Sahaja Yoga Meditation^[34] and Preksha Dhyana^[46] have a reasonably sound methodology.

Structured physical exercises (e.g., aerobic exercise) have moderate to large effects on ADHD symptoms, anxiety, executive function, and social disorders.^[53] However, the reported improvement was more from uncontrolled^[46,73] than controlled trials.^[34,74,75]

Sleep intervention reduced symptoms severity and sleep disturbances^[52] and improved psychological functioning.^[50]

MBIs varied in methods, quality, and dosage. Some improved attention, emotion regulation, and social relationships in children and adults.^[35-37,44,76-80] However, the majority of research in this area lack scientific rigor.^[79] Birdee *et al.*^[81] identified 19 mindfulness-based interventions for children (yoga-based) and concluded that most did not adequately quantify key design elements, such as instructor qualifications, attrition, and randomization methods. Randomized controlled trials of integrative improvements in specific executive function components highlight the role of neural circuitry specific to the anterior cingulate cortex and the autonomic nervous system as two brain-based mechanisms that underlie integrated body–mind

Table 2: Psychosocial intervention (n=10)

Studies	Type of interventions	Outcome variables	Outcome
Chronis et al., 2004 ^[24]	STP - an education-oriented intervention outside of regular schooling	Classroom functioning, peer functioning and behavioral improvement	Efficacious in all domains of functioning
Brown et al., 2005 ^[25]	Multimodal treatment	Improving overall functioning	Behavior therapy alone had limited effect on symptoms or functioning, combining with medication improved functioning, and decreased medication
Karande, 2005 ^[26]	Psychoeducational school interventions	ADHD symptoms	NFPP and triple P-better model for ADHD without conduct problems and comorbidity; IY-for ADHD with conduct issues and comorbidity
Chronis et al., 2006 ^[27]	Parent behavioral training	ADHD-related impairment	High efficacy of parent behavioral training
Raggi and Chronis 2006 ^[28]	Academic interventions	Academic impairment	Significant improvement in performance + symptoms reduction
Daley et al., 2009 ^[29]	NFPP- and triple P-positive parenting program and IY	ADHD with conduct issues	NFPP and triple P-better model for ADHD without conduct problems and comorbidity; IY-for ADHD with conduct issues
Fabiano et al., 2009 ^[30]	Behavioral classroom intervention	ADHD symptoms, academic performance deficits, including homework, classroom deportment, academic functioning, and organizational skills	Positive impact feasibility and sustainability issues in school
Zwi et al., 2011 ^[31]	Parent training for the preschoolers with moderate impairments	Parental stress and parental confidence	Was efficacious
Rejani et al., 2012 ^[32]	Multimodal treatment (medication + parent-counseling + attention-enhancement training)	ADHD symptoms, behavioral problems at home and school, and academic performance	Was efficacious. Parent training was superior with large effects size compared to medication and parent counseling
Gardner et al., 2015 ^[33]	Parent-assisted, friendship-building program. PEERS	Mutual friendships and peer relationships	PEERS was efficacious

STP – Summer Treatment Program; IY – Incredible years; NFPP – New Forest Parent Training Program; PEERS – Program for the Evaluation and Enrichment of Relational-Skills; ADHD – Attention deficit hyperactivity disorder

training-related improvements.^[45] A review on MBIs for ADHD suggested the usefulness of mindfulness training in improved attention and self-regulation.^[51]

The body-focused interventions have a better potentiality for replication because of strict structure of activities and better cultural-contextual compatibility than the psychosocial interventions. Although yoga- and meditation-based interventions are highly structured and originated in India, an efficacious intervention module is yet to be designed for these children. No reported Indian study on structured physical exercise or aerobics or sleep interventions was found.

Neurocognitive interventions

Compared to psychosocial and body focused interventions, computer-based attention/cognitive functioning training are globally clinicians' preferred nonpharmacological intervention because of the content structure reliability and methodology of implementation, (such as RoboMemo®-Cogmed).^[60] Therefore, the highest number of randomized control trials, systematic reviews, and meta-analysis were found in cognitive interventions for children with ADHD.

Although majority of studies^[83-86] agreed on the positive and clinically significant outcomes (especially on electroencephalogram NF and RoboMemo-Cogmed), more evidence (e.g., double-blind studies) is needed for selecting as a frontline intervention.^[82]

One Indian study has shown positive effects of NF.^[57] The resource (space in hospitals, money, and trained manpower) crunch may be the major reason for less number of studies in cognitive/neurocognitive interventions in India.

Cognitive-behavioral interventions

Despite being common and having consistent patterns of results,^[62,68,69] many cognitive-behavioral interventions (i.e., coping skills training, play-based therapies - e.g., chess training which is a brain game across cultures, group cognitive-behavioral therapy) are criticized due to inadequate empirical support and generalizability of learned skills beyond therapeutic settings.^[21,40] Interestingly, video-recorded free-play sessions with video feed-forward/feedback for promoting social play^[79] and Cog-Fun intervention for promoting executive occupational functions at home across tasks^[65] need trials.

Table 3: Body-focused intervention (n=19)

Studies	Type of Interventions	Outcome Variables	Outcome
Harrison <i>et al.</i> , 2004 ^[34]	SYM	ADHD symptoms, self-esteem, sleep quality, and quality child-parent relationship	Improvements in behavior, self-esteem and relationship quality. Children benefitted at home (better sleep patterns, less anxiety) and at school (more able to concentrate, less conflict). Parents reported happier feeling, less stressed and improved management of child's behavior
Tang <i>et al.</i> , 2007 ^[35]	Short-term mindfulness-based meditation training	Attention and self-regulation	Significant improvement in both
Grosswald <i>et al.</i> , 2008 ^[36]	Transcendental meditation	Stress, anxiety, ADHD symptoms, and executive function	Significant improvement in all the domains measured
Zylowska <i>et al.</i> , 2008 ^[37]	Eight adolescents and 8 weeks of mindfulness training program: feasibility testing	ADHD symptoms, attention and cognitive inhibition, anxiety and depressive symptoms	Significant improvement in behavioral and neurocognitive impairments. Good feasibility
Medina <i>et al.</i> , 2010 ^[38]	Physical exercise	Sustained attention and ADHD symptoms	Marked improvement in sustained attention and symptoms
Singh <i>et al.</i> , 2010 ^[39]	Mindfulness training for parents and children	ADHD symptoms and compliance	Significant improvement in both domains
van den Hoofdakker <i>et al.</i> , 2010 ^[40]	BPT as adjunct to routine care	Behavioral problems and ADHD symptoms	Most useful when mothers have high parenting self-efficacy and in children with no or single-type comorbidity.
Sciberras, <i>et al.</i> , 2010, 2011 ^[41,42]	Sleep intervention	Sleep problems, quality of life, daily functioning, and working memory	Efficacious in reducing the severity of all variables
Gapin <i>et al.</i> , 2011 ^[43]	PA	ADHD symptom, particularly behavioral and cognitive symptoms	Potential for acute and chronic PA to mitigate symptoms
Chiesa and Malinowski, 2011 ^[44]	Mindfulness-based practices (relaxation, focused breathing, and mental imagery, awareness of body-mind)	Attention, regulation of emotion and social relationship	Effectiveness in all aspects of functioning
Tang <i>et al.</i> , 2012 ^[45] Meta-analysis	Integrated body-mind training (body relaxation, mental imagery, and mindfulness training)	Executive functions and associated behaviors	Significant improvement in executive functions
Mehta <i>et al.</i> , 2012 ^[46]	Peer-mediated interventional program (yoga, meditation, and play therapy)	Students' school performance	Significant improvement sustained throughout the year
Pontifex <i>et al.</i> , 2013 ^[47]	Aerobic exercise	Neurocognitive function and inhibitory control	Positive implications for some aspects of neurocognitive function and inhibitory control
Van de Weijer-Bergsma <i>et al.</i> , 2012 ^[48]	Mindfulness training for adolescents + mindful parental training	Attention, behavioral problems, mindful awareness, executive functioning of child as well as stress, and parental practices	Improvement in adolescents' attention, behavior problems, and executive functioning. Fathers reported reduced parenting stress and over-reactive parenting
Van der Oord <i>et al.</i> , 2012 ^[49]	Mindfulness training for children and parallel mindful parenting training	ADHD and ODD symptoms, parenting stress, parental over-reactivity, permissiveness, and mindful awareness	Significant reduction of symptoms and a significant increase of mindful awareness along with reduction of parental stress and over-reactive parenting
Keshvarzi <i>et al.</i> , 2014 ^[50]	Sleep intervention	Emotional-social-behavioral functioning	Significant improvements in mood, emotions, and relationships. Parents also reported similar improvement along with marked improvement in physical and psychological well-being and social acceptance
Schmiedeler 2015 ^[51]	Mindfulness training	Attention and self-regulation skills	Mindfulness training in effective for improving both attention and self-regulation
Hiscock <i>et al.</i> , 2015 ^[52]	Sleep intervention including Sleep hygiene practices and standardized behavioral strategies	Severity of symptoms, sleep problems, behavior, quality of life, daily functioning, working memory, and parent mental health (depression anxiety and stress)	Significant improvement in symptoms severity. Improved children's sleep, behavior, quality of life, and functioning, till 6 months postintervention

Contd...

Table 3: Contd...

Studies	Type of Interventions	Outcome Variables	Outcome
Cerrillo-Urbina <i>et al.</i> , 2015 ^[53]	BMT	Attention, hyperactivity, impulsivity, anxiety, executive function, and social disorders	Physical exercise (short-term aerobic exercise) had moderate to large effect size on mitigating symptoms, anxiety, executive function and social disorders

SYM – Sahaja Yoga Meditation; BPT – Behavioral parent training; PA – Physical activity; BMT – Body–mind training; ODD – Oppositional defiant disorder; ADHD – Attention deficit hyperactivity disorder

Table 4: Neurocognitive intervention (n=7)

Studies	Type of interventions	Outcome variables	Outcome
Shalev <i>et al.</i> , 2007 ^[54]	CPAT	Academic and attentional improvements	Significant improvement in reading comprehension, passage copying. Significant reduction of inattentiveness
Bakhshayesh <i>et al.</i> , 2011 ^[55]	EEG-NF	Psychophysiological measures, behavioral rating, and psychometric measures	NF effectively reduced inattention symptoms and reaction time in neuropsychological tests
Steiner, <i>et al.</i> , 2011 ^[56]	NF and CT	Teacher and parent report of symptoms + classroom observation of behavior	NF is a promising attention-training intervention
Shereena <i>et al.</i> , 2011 ^[57]	EEG-NF compared to EMG-BF	Symptoms, inattention, psychophysiological, and psychometric measures	EEG-NF is superior as compared to EMG-BF in reducing primary symptoms + other outcome variables
Tamm <i>et al.</i> , 2013 ^[58]	Pay attention training	Symptoms, ability to focus, and executive functioning	Significant improvement in symptoms, ability to focus, and parent ratings of executive functioning. No treatment effects on other neuropsychological outcomes and teacher ratings
Gharebaghy <i>et al.</i> , 2015 ^[59]	CO-OP	Goal attainment and motor proficiency (motor-based performance difficulties)	Significant improvement in goal attainment and motor proficiency
Spencer-Smith and Kingberg 2015 ^[60]	Working-memory training	Inattention in daily life functioning	Significant improvement in inattention

CO-OP – Cognitive Orientation to daily Occupational Performance; CPAT – Computerized progressive attentional training; EEG-NF – Electroencephalography neurofeedback; EMG-BF – Electromyography biofeedback; CT – Cognitive training

Table 5: Cognitive-behavioral intervention (n=10)

Studies	Type of interventions	Outcome variables	Outcome
Karande 2005 ^[26]	Psychoeducational interventions at school level	Functioning and academic performance	Significant improvement in both domains
Pfiffner <i>et al.</i> , 2007 ^[61]	Behavioral psychosocial treatment	Inattention, sluggish cognitive tempo, and functional impairment of ADHD	Significant improvement in all variables
Fabiano <i>et al.</i> , 2009 ^[62]	BPT versus COACHES program (including BPT plus sports skills training)	Functioning	Both groups improved on child behavior. No significant difference on ADHD-related measures
Park <i>et al.</i> , 2011 ^[63]	Cognitive-behavioral therapy	Symptoms	Significant improvement in symptoms
Zwi <i>et al.</i> , 2011 ^[64]	Parent training intervention	Parental stress and parental confidence	Significant effect on the behavior, reducing parental stress, and enhancing parental confidence
Hahn-Markowitz <i>et al.</i> , 2011 ^[65]	Cognitive-function intervention	Executive functioning of child	Significant improvements in executive function which continued in follow-up
Park <i>et al.</i> 2015 ^[66]	Cognitive-behavioral therapy	Self-control, lack of attention, social skills, and hyperactivity	Significant positive effects on symptoms and outcome variables
Rosenberg <i>et al.</i> , 2015 ^[67]	Cognitive-functional group intervention	Daily functioning, executive function, and social functioning for preschoolers	Significant improvement in daily functioning, social functioning, and executive functioning
Vidal <i>et al.</i> , 2015 ^[68]	Group cognitive-behavioral therapy	ADHD symptoms and related functional impairment	Was efficacious in reducing symptoms and functional impairment in adolescents
Blasco-Fontecilla <i>et al.</i> , 2015 ^[69]	Chess training program	ADHD symptoms	Significant improvement in Inattentiveness

BPT – Behavioral parent training; COACHES – Coaching Our Acting-Out Children; Heightening Essential Skills; ADHD – Attention deficit hyperactivity disorder

Intervention characteristics

Participants' characteristics

The studies had a wide range of sample size between 11 and 69. The smaller sample size could be due to the complex nature of the ADHD itself to deal with convenience and availability of resources. The target age group (3–18 years) and settings (home, school, camping, clinic, etc.) varied widely.

Setting's characteristics

Majority of the studies do not specify the settings and details of professionals involved in the intervention. Large body of studies opted for school/classroom followed by home and hospital based interventions. A few studies described the details of the physical set up of the place and the physical environment where the interventions were implemented. Indian studies suffered more from methodology issues and very few controlled studies are available to build any scientific rigor.

Characteristics of content details of the intervention

The structure of content, duration, procedure of administration, and detail of interventionist, outcome variables, and tools varied widely depending on the objective and methodology of the intervention. More psychosocial and cognitive-behavioral interventional studies lacked essential information about content/session details, procedure and qualification, and/or experience of the intervention provider than body-focused and neurocognitive interventions.

Issues and concerns

Except few packaged interventions, no intervention was adopted for efficacy testing by other authors other than the original author. Despite having more than thirty types of interventions and having significant positive impact on core symptoms, other socioemotional and behavioral symptoms, generalization, and contextualization need careful decisions. Hence, the choice of nonpharmacological intervention still remains inconclusive. Methodological issues and culture-compatibility (other than few neurocognitive interventions) are the key issues for India and other countries.

Gaps and needs

The following gaps should be addressed in Indian research which lacks:

- Controlled studies with robust methodology
- Manually guided standard interventions
- Feasibility and cultural compatibility testing trial studies
- Structured and modular format of existing interventions (yoga, meditation, and breathing exercises)
- Cost-effective manual CT kit.

CONCLUSION

Three programs (NFPP, Triple P, and IY) in parent training have demonstrated required efficacy thus can be recommended for preschool children. The situation is complex for school-age children where interventions normally include more settings simultaneously (family and school) and have psychological and psychoeducational components, including individual sessions with the children, training for parents and teachers, and adaptations in the school.^[87] Indian literature provides leads for interventions in cognition, sleep, and social skills domains. A standard yoga module with proven feasibility and effectiveness in India would expand the scope of replication. Compatibility, adaptability, and training in implementing should be considered if opting any packaged non-Indian origin intervention program. Newly developed and adapted interventions should be flexible enough to be customized for better clinical practice.

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Conflicts of interest

There are no conflicts of interest.

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