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, sociobehavioral, and cognitive disorder characterized by developmentally inappropriate levels of inattention, impulsivity, and hyperactivity often persist into adulthood. Its clinical complexity and heterogeneity resulted in largest referrals in mental health, educational, and medical settings in past. ADHD results in poor performance of vigilance, working memory, sustained attention, planning, and executive functions.

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**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) 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. Indian control trial by Rejani et al. 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 reported that parental perception and behavior toward ADHD...
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

| 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 |

### Table 1: Literature search

CAM – Complementary and alternate medicine; ADHD – Attention deficit hyperactivity disorder; SLD – Specific learning disorder; ODD – Oppositional defiant disorder
NFPP and triple P—better model for ADHD-related impairment

Parent behavioral training

Behavioral classroom intervention

Parent-assisted, friendship-building program, PEERS

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 efficacy. |
| 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[^8].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 et al., 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 et al., 2007[35]          | Short-term mindfulness-based meditation training           | Attention and self-regulation                                                     | Significant improvement in both                                          |
| Grosswald et al., 2008[36]     | Transcendental meditation                                 | Stress, anxiety, ADHD symptoms, and executive function                            | Significant improvement in all the domains measured                      |
| Zylowska et al., 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 et al., 2010[38]        | Physical exercise                                         | Sustained attention and ADHD symptoms                                             | Marked improvement in sustained attention and symptoms                   |
| Singh et al., 2010[39]         | Mindfulness training for parents and children              | ADHD symptoms and compliance                                                      | Significant improvement in both domains                                  |
| van den Hoofdakker et al., 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, et al., 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 et al., 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 et al., 2012[45]          | Meta-analysis                                             | Executive functions and associated behaviors                                      | Significant improvement in executive functions                           |
| Mehta et al., 2012[46]         | Peer-mediated interventional program (yoga, meditation, and play therapy) | Students’ school performance                                                      | Significant improvement sustained throughout the year                   |
| Pontifex et al., 2013[47]      | Aerobic exercise                                          | Neurocognitive function and inhibitory control                                    | Positive implications for some aspects of neurocognitive function and inhibitory control |
| Van de Weijer-Bergsma et al., 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 et al., 2012[49]  | Mindfulness training for children and parallel mindful parenting training | ADHD and ODD symptoms, parenting stress, parental over-reactivity, permisiveness, 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 et al., 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 et al., 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 et al., 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 et al., 2007[54]        | CPAT                  | Academic and attentional improvements                                             Significant improvement in reading comprehension, passage copying. Significant reduction of inattentiveness                                           |
| Bakhshayesh et al., 2011[55]   | EEG-NF               | Psychophysiological measures, behavioral rating, and psychometric measures        NF effectively reduced inattention symptoms and reaction time in neuropsychological tests                                                                                                     |
| Steiner, et al., 2011[56]      | NF and CT             | Teacher and parent report of symptoms + classroom observation of behavior          NF is a promising attention-training intervention                                                                                                                                                |
| Shereena et al., 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 et al., 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 et al., 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 et al., 2007[61]      | Behavioral psychosocial treatment                   | Inattention, sluggish cognitive tempo, and functional impairment of ADHD          Significant improvement in all variables                                                                                                                                                     |
| Fabiano et al., 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 et al., 2011[63]          | Cognitive-behavioral therapy                           | Symptoms                                                                          Significant improvement in symptoms                                                                                                                                                            |
| Zwi et al., 2011[64]           | Parent training intervention                          | Parental stress and parental confidence                                           Significant effect on the behavior, reducing parental stress, and enhancing parental confidence                                                                                                      |
| Hahn-Markowitz et al., 2011[65] | Cognitive-function intervention                    | Executive functioning of child                                                   Significant improvements in executive function which continued in follow-up                                                                                                                                                       |
| Park et al. 2015[66]           | Cognitive-behavioral therapy                           | Self-control, lack of attention, social skills, and hyperactivity                 Significant positive effects on symptoms and outcome variables                                                                                                                                              |
| Rosenberg et al., 2015[67]     | Cognitive-function group intervention                 | Daily functioning, executive function, and social functioning for preschoolers    Significant improvement in daily functioning, social functioning, and executive functioning                                                                                                                                 |
| Vidal et al., 2015[68]         | Group cognitive-behavioral therapy                   | ADHD symptoms and related functional impairment                                  Was efficacious in reducing symptoms and functional impairment in adolescents                                                                                                                                               |
| Blasco-Fontecilla et al., 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
CONCLUSION

Three programs (NFP, 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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There are no conflicts of interest.

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