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Gestalt of non-pharmacological management of ADHD

Hemant Nandgaonkar*

Occupational therapy, Seth GS medical college, KEM Hospital, Mumbai, Maharashtra University of health sciences (MUHS), India

*Corresponding author

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A B S T R A C T

There are varieties of interventions available for the management of ADHD. As a clinician, clients pose many questions related to many known and unknown non-pharmacological interventions to Occupational Therapist. In this context, it was thought that there is need to have an overview of all interventions. To have an overview of problems related to ADHD and its management options along with present evidence related to outcome. Literature search from various databases with search terminology "non-pharmacological interventions of ADHD, psychosocial intervention, Occupational Therapy. The interventions were categorized into five types. The terminology of categories is familiar to Occupational Therapists. Recent and highest level of evidence available is cited for reference. this overview will be helpful for parent education and briefing them about options available for the intervention without medication. This overview does not include statistics. Systematic review approach was not adopted during the entire literature search. Meta-analysis can be done in the future.

Introduction

Overview (Grant & Booth, 2009)of Problem Areas in the Individuals with ADHD

ADHD is a neuro developmental disorder, the symptoms of which often emerge during the preschool years (Curchack-Lichtin, 2012; White B, 2005). A developmental conceptualization posits (Sonuga-Barke,

2010), ADHD as emerging from multiple underlying developmental processes; it is not a fixed or static disorder. The originating risk for ADHD has potentially being moderated by later factors to alter the trajectory during development. ADHD as the product of a dynamic interplay between numerous individual risk factors(Sonuga-Barke, 2010). It is etiologically,

physiologically and phenomenologically heterogeneous. Onset of ADHD occurs as a conversion or transition of degree rather than of kind. ADHD have different developmental phenotypes like early versus late emerging; persistent versus fluctuating.

Attention deficit hyperactivity disorder (ADHD) is comprised of a persistent pattern of symptoms of hyperactivity, impulsiveness and/or lack of attention, which is more frequent and severe than usual for that child's age, and causing a significant functional impairment in school or work performance and in the activities of daily life (Catala-Lopez et al., 2015). Impairments of self-regulationⁱ result in developmentally inappropriate inattentive, hyperactive and impulsive behaviors that define Attention-Deficit/Hyperactivity Disorder (ADHD) (Shiels, Tamm, & Epstein, 2012). It has impact on various performance skills of the children as listed below (Patrica Bowyer, 2009).

a. Knowledge

- i. Chooses
- ii. Uses
- iii. Handles
- iv. Heeds
- v. Inquires

b. Temporal organization

- i. Initiates
- ii. Continues
- iii. Sequences
- iv. Terminates

c. Organization of space & objects

- i. Searches & locates
- ii. Gathers
- iii. Organizes
- iv. Restores
- v. Navigates

d. Adaptation

- i. Notices & respond
- ii. Accommodates

- iii. Adjusts

e. Physicality

- i. Contacts
- ii. Maneuvers

f. Information exchange

- i. Expresses
- ii. Modulates

g. Relations

- i. Collaborates
- ii. Conforms
- iii. Focuses
- iv. Relates
- v. Respects

Spatial working memory (SWM)ⁱⁱ is known to be impaired in children with ADHD-Combine Type, whether anxiety is present or not (Vance, Ferrin, Winther, & Gomez, 2013). It is found that children with ADHD, the visual perception is lower in those children with co-morbid Sensory Processing Disorder (SPD). Visual perception may be related to sensory processing, especially in the reactions of vestibular and proprioceptive senses. Regarding academic performance, it is necessary to consider how sensory processing issues affect visual perception in children with ADHD (Jung, Woo, Kang, Choi, & Kim, 2014). Sensory processing problems in children with ADHD are more common than in typically developing children (Ghanizadeh, 2011; Reynolds & Lane, 2008). Sensory processing problems in children with ADHD are more common than in typically developing children. Findings do not support that ADHD subtypes are distinct disorders with regard to sensory processing problems. However, co-morbidity with oppositional defiant disorder and anxiety are predictors of more severe sensory processing problems in children with ADHD (Ghanizadeh, 2011). Somatosensory and vestibular system plays

an essential role in concrete attentional demands and visual and auditory systems facilitate cognitive and reflective attention (Trupti Nikharge, 2002).

According to the delay aversion model, the primary deficit in ADHD is a preference for an immediate reward or an aversion to delay (Yang, 2007). Children with ADHD have been reported to exhibit problems in time perception/ time sense, time management, time orientation (J, 2009). There is existence of a generic time perceptionⁱⁱⁱ deficit, which is probably due to the involvement of a dysfunctional fronto-striato-cerebellar network in this capacity, especially the presence of deficits in basic internal timing mechanisms (Yang, 2007). They demonstrate deficiency in behavior inhibition, slower processing and responding to visually presented stimuli (Alderson, Rapport, Sarver, & Kofler, 2008). Post-error slowing (i.e., slowing of a response on correct trials following an error) is impaired in children with ADHD Inattentive type, but not ADHD-Combined type, on a simple attention task (Shiels et al., 2012).

In terms of executive functioning, the most consistent and strong associations are seen for response inhibition, vigilance, working memory, and planning. In terms of non-executive deficits, associations are seen with timing, storage aspects of memory, reaction time variability, and decision making (Anita Thapar, 2015).

Activity level in all children was associated with central executive but not storage/rehearsal functioning, and higher activity rates exhibited by children with ADHD under control conditions were fully attenuated by removing variance directly related to central executive processes (Rapport et al., 2009).

Emotional instability is a common associated feature and may be the main presenting complaint (Asherson, 2012). ADHD has distinct trait profile exhibiting lower means on Effortful Control, Conscientiousness, Benevolence and Emotional Stability, higher means on Emotionality, Activity, and Negative Affect, but similar levels of Surgency, Shyness, and Extraversion (De Pauw & Mervielde, 2011).

Current evidence and clinical practice suggest that, even if ADHD is not purely a result of sleep disturbance, it is conceivable that, at least in some children, the condition is a “24-hour” disorder, and that sleep disruption caused by increased nocturnal activity contributes to daytime symptomatology (Konofal, Lecendreux, & Cortese, 2010). Sleep problems are usually transient in children with ADHD; however, in a subgroup of children, they tend to persist in the medium term (Lycett, 2014).

Parental ADHD status appears to confer different risks for the severity of hyperactive-impulsive and inattentive symptoms depending on parental sex; however, parental ADHD self-report scale score has low to negligible correlation with proband’s ADHD severity. Biparental ADHD does not appear to have an additive or synergistic effect on the proband’s ADHD severity (Takeda et al., 2010).

ADHD-related dysfunction within multiple neuronal systems involved in higher-level cognitive functions but also in sensorimotor processes, including the visual system, and in the default network. (Samuele Cortese, 2012)

- a. Hypo activation in the frontoparietal executive control network, putamen, and ventral attention network (consistent with the classical model of

- ADHD as a disorder of deficient fronto-striatal activation)
- b. Hyper activation, particularly in the default network and visual circuits (possible compensatory mechanisms)
 - c. Individuals with ADHD compensate for impaired function in prefrontal and anterior cingulate cortex by overreliance (relative to comparisons) on brain regions associated with visual, spatial, or motoric processing.

Boys with ADHD have more comorbid externalizing problems and girls with ADHD (especially adolescents) have more comorbid internalizing problems such as depression and anxiety (although no referred samples do not find gender differences in rates of coexisting psychiatric disorders in pediatric samples)(Rucklidge) .

Childhood disorders and conditions that can mimic ADHD in young children (Richard Lougy, 2007)

1. Unidentified learning disability
2. Reactive attachment disorder
3. Child abuse
(sexual, physical, mental)
4. Adjustment disorder
(home or school changes)
5. Depression
6. Bipolar disorder
7. Tourette's syndrome
8. Regulatory disorder
9. Pervasive developmental disorder
10. Fragile X syndrome
11. Anxiety disorder
12. Oppositional defiant disorder
13. Separation anxiety disorder
14. Mild seizure disorder
15. Language based disorder
16. Sensory deficits
17. Sensory integration dysfunction

18. Mild cerebral palsy
19. Malnourishment
20. Sleep deprivation (including sleep apnea) (higher daytime sleepiness, more movements in sleep, and higher apnea-hypopnea indexes) (al, 2006)
21. Reaction to medication
22. Hyperthyroidism
23. Pinworm infection
24. Bad fit with the environment (temperament)
25. Post-traumatic stress disorder (PTSD)

Overview (Grant & Booth, 2009) of Non pharmacological Intervention

Increasing apprehension regarding stimulant medication and the ramifications of its use on children, there is a need to evaluate other alternatives. There are many non-pharmacological interventions documented in the literature. It has been classified in different ways. We used following headings to categorize the different types of interventions.

A. Impairment-Oriented Approaches: Focusing on Body Function and Structure to Improve Activity and Participation(Polatajko, 2010): Interventions focused on impairments are based on the assumption that competent occupational performance depends on properly functioning nervous and musculoskeletal systems and that damage or abnormal development of one or more of these systems results in dysfunction. Impairment-oriented interventions aim specifically to reduce impairment and restore function through targeting the impaired body structure and function. The intention is that the remediation of the impairment(s) will lead to an increase in activity performance and participation.

B. Performance-Oriented Approaches: Focusing on Performance to Improve Activity and Participation: Increasing Activity Performance and Participation: Interventions focused on performance are not directly concerned with the underlying impairment in body structure and function; rather, they focus on the performance directly, often relying on systems theories to understand the reasons for the observed activity limitations and participation restrictions.

Performance-oriented interventions aim to improve performance of a specific activity and, thereby, participation. These approaches include direct skills teaching (i.e., approaches that provided specific training of the activities of interest) and cognitive-based, performance-based interventions (i.e., approaches that use cognitive strategies to support the specific training of the activities of interest [e.g., Cognitive Orientation to daily Occupational Performance or CO-OP]). The aim of direct skills teaching approaches, as the name suggests, is to teach specific skills, such as throwing a ball or skating. Such approaches make use of teaching, coaching, and motor learning principles to enable the child to acquire set skills.

The aim of cognitive-based approaches is to teach children to use strategies that enable their learning of chosen activities. Both are embedded in a learning paradigm.

C. Family-Based Interventions (Kaslow, Broth, Smith, & Collins, 2012), Family-School Intervention (Jennifer A. Mautone, 2012)

D. Environmental adaptation(R. F.-. Chu S, 2007)

E. Mixed

A. Impairment-Oriented Approaches: Focusing on Body Function and Structure to Improve Activity and Participation(Polatajko, 2010)

a. Cognitive based interventions: involve training programs involving repeated exposure to cognitive stimuli e.g. fixation or attention training(Toplak, Connors, Shuster, Knezevic, & Parks, 2008).

a. Sensory Based

1. Ayres Sensory integration Therapy® (Roseann C. Schaaf, 2005a; Section On et al., 2012): occupational therapy with a sensory integration approach (OT/SI) is designed to guide intervention for children who have significant difficulty processing sensory information, which restricts participation in daily life activities (Parham et al., 2007; Roseann C. Schaaf, 2005b).

2. Brain Gym®^{iv} movements, exercises, or activities refer to the original 26 Brain Gym movements, sometimes abbreviated as the 26. These activities recall the movements naturally done during the first years of life when learning to coordinate the eyes, ears, hands, and whole body. The twenty-six activities, along with a program for “learning through movement” were developed by educator and reading specialist Paul E. Dennison and his wife and colleague, Gail E. Dennison who say that the interdependence of movement, cognition, and applied learning is the basis of their work (“Freesia” Peterson, 2005).

3. Training Executive, Attention and Motor Skills (TEAMS), a program developed for 4- and 5-year-old children with ADHD, uses games

- designed to target an array of neurocognitive skills (e.g., inhibition, sustained attention, memory, planning, and visuospatial and motor skills) frequently impaired in the disorder (Halperin JM, 2012).
4. Enhancing Neurocognitive Growth with the Aid of Games and Exercise (ENGAGE) is an early intervention for 3- and 4-year-old children with difficulties in self-control. ENGAGE targets three areas of self-control that are deficient in children with ADHD:
 - a. Behavior,
 - b. Cognition, and
 - c. Emotion (Healey DM, 2012)
 5. Provide normal sensory stimuli while facilitating normal responses; address muscle tightness, weakness, and postural misalignment
 6. Virtual Reality (Wang & Reid, 2011): Three major classes of VR display systems are identified that can be characterized by the type of human-computer interaction provided:
 - a. (1) feedback-focused interaction,
 - b. (2) gesture- based interaction, and
 - c. (3) haptic-based interaction.
 7. Home programming, including PACE (Positive Approaches to Children's Education; 4 activities (drinking water, brain buttons, cross crawls, Cooks Hook up) to ensure learning readiness; and Dennison Laterality Repatterning, a 5-step balance process that simulates stages of laterality infancy to walking (Inder, 2004).
 8. Tai Chi, a form of Chinese low impact mind-body exercise (Chenchen Wang1, 2010; Hernandez-Reif M, 2001)
 9. Acupuncture (complementary and alternative medicine: CAM)(Li et al., 2011) – NO evidence.
 10. Transcutaneous Electrical Nerve Stimulation (TENS)(Toplak et al., 2008)
 11. Beach flower Remedies (five flower essences) (Pintov S, 2005)
 12. Yoga
 13. Aquatic therapy^v(Chang, Hung, Huang, Hatfield, & Hung, 2014)
 14. Massage therapy: twice weekly massage improves short term mood state and classroom behavior.(Khilnani S, 2003; Network, 2009)
 15. Meditation^{vi}: (Krisanaprakornkit, Ngamjarus, Witoonchart, & Piyavhatkul, 2010) In addition to increased attention, meditation may produce a state of calmness and contentment which is generally lacking in the ADHD population (Jensen & Kenny, 2004) (Zylowska L, 2008)
 16. Mindfulness training^{vii}: Mindfulness training is an intervention based on eastern meditation techniques, that helps increasing awareness of the present moment, enhances non-judgmental observation, and reduces automatic responding (Oord, 2011).
 17. Dance therapy (Majorek M., 2004)
 18. Wearing a weighted vest

19. Sensory diet
Attentional focus by increasing self-focus in children with ADHD.
20. Therapeutic Listening program (Frick S, 2000)
21. Vestibular stimulation
22. Oral-motor chewing
23. Chiropractic Treatment ^{viii}: (Young, 2007)
24. Vision Therapy, or Vision Training(Lemer, 2007)
25. Integrated Listening Systems: iLs Focus Sensory Motor Program is effective in remediating some of the functional problems of children with sensory over-responsivity and auditory processing challenges(Shoen, 2015).
26. Craniosacral Therapy
27. MORE: Integrating the Mouth with Sensory and Postural Function (Oetter P, 1995)
28. EMG biofeedback (neurotherapy) and relaxation training
29. Interactive computer play (Sandlund, McDonough, & Hager-Ross, 2009)
30. EEG biofeedback or neuro-feedback^{ix} - (Gevensleben et al., 2009). Electroencephalographic (EEG) biofeedback involves inducing sensorimotor 12-15 Hertz or 15-18 Hertz beta band EEG rhythms and suppressing theta rhythms by visual and auditory feedback. (Kuhl, 2010)
31. Mirror Feedback (Arnold, 1999) - Mirrors have been proposed as a way of increasing self-control and
32. Physical Activity^x(Smith et al., 2013)
33. Computerized Progressive Attentional Training (CPAT) program^{xi} (Shalev, Tsal, & Mevorach, 2007)
34. Movement therapy: Warm-up (greetings while clapping), activities (e.g., obstacle course), cool down (song and movement).
 - b. Treatment of executive dysfunctions(Dawson P, 2004)
 - c. Time management (Henderson, 2008)
 - i. Use a clock or wristwatch
 - ii. Use a calendar
 - iii. Practice sequencing activities
 - iv. Create a daily activity schedule
 - d. Play based intervention(Wilkes, 2011) – use of play, feedback, and parental education and found a large effect in improving the social play in all children
 - a. Behavior therapy^{xii}(Buffalo; Committee on Quality, 2001). There are three parts of effective behavioral interventions for ADHD children—parenting training, school interventions, and child-focused treatments.
 - i. Positive reinforcement
 - ii. Time-out
 - iii. Response cost
 - iv. Token economy
 - b. Dietary treatments,**
Removal of additives, colorings, or sugar or Addition of high doses of vitamins, minerals, or other “health food” supplements

Free fatty acid supplementation and artificial food color exclusions (Sonuga-Barke, 2013).

c. Psychoanalysis (SALOMONSSON, 2006): This particular technique is used on the belief that *“Once you see beneath their violent or scornful, indifferent or incomprehensible appearance, you notice their longing to express their inner worlds.*”

d. Homeopathy (Coulter & Dean, 2007)

B. Performance-Oriented

Approaches: Focusing on Performance to Improve Activity and Participation: Increasing Activity Performance and Participation

a. The Cog-Fun intervention is theoretically driven and addresses deficient goal-oriented processes in children with ADHD. It supports participation through the learning of specific executive strategies (Stop, Plan, and Review) in a context of achieving occupational goals that target self-regulation, working memory^{xiii}, and planning. By definition, the goals are meaningful to the child and harness motivational and cognitive resources toward goal oriented behavior(Hahn-Markowitz, Manor, & Maeir, 2011). There is provision of cognitive and motivational tools for performing complex daily occupations that require Executive Function.

b. The motor imagery program: included visual imagery, visual modeling of motor skills, mental rehearsal, and practice.

c. Direct Skills Teaching.

- i. Task-specific warm-up
- ii. Mental preparation
- iii. Imagery training: On computer, increasing complexity:

1. Visual imagery exercises predictive timing,
2. Relaxation and mental preparation,
3. Visual modeling of motor skills,
4. Mental rehearsal from an external/internal perspective,
5. Practice

- iv. Perceptual–motor training: Gross and fine motor and perceptual–motor activities

- d. Interventions to increase following(Patrica Bowyer, 2009)

- i. Safety awareness
- ii. Knowledge
- iii. Temporal organization
- iv. Organization of space and objects
- v. Adaptation
- vi. Physicality
- vii. Information exchange

- e. Organizational skills interventions(Improvement, 2012; Langberg, Epstein, & Graham, 2008): for children and adolescents with ADHD typically focus on academic aspects of organization, such as

- i. Classroom preparation,
- ii. Homework management and
- iii. Organization of class materials.
- iv. Organizational skills interventions for children typically incorporate behavioral techniques such as rehearsal, prompting, shaping and contingency management to teach and promote skills use and their generalization

Examples(Improvement, 2012)

1. Behavior: Difficulty sequencing and completing steps to accomplish specific tasks (e.g., writing a book report or term paper, organizing paragraphs, solving division problems)

Accommodation: Break task into workable and manageable component tasks. Provide examples to accomplish task.

2. Behavior: Difficulty prioritizing from most to least important.

Accommodation: Prioritize assignments and activities. Provide a model to help students. Post the model and refer to it often.

f. Cognitive-Based Approaches.

- i. Cognitive-behavioral approaches have included training in self-instructions, problem-solving, self-reinforcement, and self-redirection to cope with errors.(Toplak et al., 2008)
- ii. CO–OP (Cognitive Orientation to Daily Occupational Performance -task-oriented approaches): Children taught to apply cognitive strategy to solve their motor problems and learned to perform 3 chosen goals. Guidance is used by occupational therapists to enable children to discover strategies to help them learn their goals. Promote Generalization and transfer(Gantschnig, 2014).
- iii. Problem-Solving Strategies/Cognitive Behavioral Therapy(Improvement, 2012)^{xiv} - Modern CBT refers to a family of interventions that combine a variety of cognitive, behavioral, and emotion-focused techniques. Although these strategies greatly emphasize

cognitive factors, physiological, emotional, and behavioral components are also recognized for the role that they play in the maintenance of the disorder(Stefan G. Hofmann, 2012).

- iv. ALERT Program: How does your engine run?^{xv}(Aishwarya Swaminathan, 2014).

- v. Teach the child self-monitoring skills (e.g., ask the child to monitor their attention levels for a given task and then ask them to rate whether they were paying attention or not)(Amarasinghe, 2010).

- vi. Teach the child self-reinforcement (e.g., the child is taught to recognize and value their achievements) (Amarasinghe, 2010).

g. Social skill training

- i. Group treatment which focused on social skills training, through meaningful occupations (e.g. art, games, cooking) - fixed structure, including relaxation exercises at the beginning of the session, followed by different activities (arts, games, cooking), and finally, cleaning up the room together. Each meeting had a social theme, with the goal of acquiring social skills such as listening, waiting in turn, and learning how to behave when irritated by another child. The activity was suited to the specific social skill (e.g. a game that requires waiting in turn). The session lasted an hour, with the parents joining the group for the last 15 minutes to inform them on details of the specific session and homework given to the children, and to give guidance on how to implement skills practiced in the group at home(Gol, 2005).

- ii. Direct intervention (including role plays) with the child to improve social communication skills focusing on both specific micro-skills (e.g., appropriate eye contact, voice volume and tone, body positioning) and macro-skills which involve more complex interactions (e.g., giving compliments, constructive feedback, turn-taking, listening skills, conflict resolution, assertion)(Amarasinghe, 2010)
 - iii. Problem Solving Communication Training Program (PSCT) procedures developed by Robin and Foster(RUSSELL A. BARKLEY, 2004). This treatment program contains three major components for changing parent-adolescent conflict:
 1. Problem-solving: training parents and teens in a 5- step problem solving approach (i.e., problem definition, brainstorming of possible solutions, negotiation, decision making about a solution, implementation of the solution).
 2. Communication training: helping parents and teens develop more effective communication skills while discussing family conflicts, such as speaking in an even tone of voice, paraphrasing others' concerns before speaking one's own, providing approval to others for positive communication, and avoiding insults, put-downs, ultimatums, and other poor communication skills
 3. Cognitive restructuring: helping families detect, confront, and restructure irrational, extreme, or rigid belief systems held by parents or teens about their own or others' conduct.
 4. Floortime®: As the name suggests, you get down on the floor but you do a whole lot more than play. The Greenspan Floortime Approach is a system developed by the late Dr. Stanley Greenspan. Floortime meets children where they are and builds upon their strengths and abilities through interacting and creating a warm relationship. It challenges them to go further and to develop who they are rather than what their diagnosis says. In Floortime, you use this time with your child to excite her interests, draw her to connect to you, and challenge her to be creative, curious, and spontaneous—all of which move her forward intellectually and emotionally ().
- C. Family-Based Interventions (Kaslow et al., 2012), Family-School Intervention (Jennifer A. Mautone, 2012),**
- a. Parent training programmes are psychosocial interventions aimed at training parents in techniques to enable them to manage their children's challenging behavior (Zwi, Jones, Thorgaard, York, & Dennis, 2011)
 - b. ADHD Support Groups
 - c. Advocacy Groups
 - d. Educational Websites: healthcare professionals should provide people with ADHD and/or their families with relevant information (including written information) about ADHD at every single stage of their care(Ryan, 2015).
 - e. Parent conferences. Teacher partnering with parents entails including parental input in behavioral intervention strategies, maintaining frequent

communication between parents and teachers, and collaborating in monitoring the student's progress.

- f. Parent child interaction therapy
- g. Triple P – Positive parenting program – multi level parenting intervention
- h. The Incredible years
 - i. Basic – parenting skills. Includes interactive play, positive reinforcement, and non – averse discipline strategies.
 - ii. Advance – interpersonal skills
 - iii. Education – academic skills
- i. Family skill training interventions –
 - i. Single-family Intervention This format engages a single family in behavior therapy, working with two therapists, one implementing the child-focused intervention and the other providing behavioral parent training. Within this format, the parents and their child will attend separate, but adjacent therapy sessions for the first 35-45 minutes of the session. When all of the child-focused therapy objectives have been achieved, the child therapist transitions with the child to join his/her parents for an integrated family consultation
 - ii. Modified Single-family Intervention
 - iii. Multi-family Intervention(Curtis DF, 2013)

D. Environmental adaptation
(R. F.-. Chu S, 2007)

- a. Adaptation of environment - a calming environment with less stimulation is desirable to maintain their attention

control and promote self-regulation, such as a classroom with a clear layout and a neutral color scheme.

- i. Provide calming manipulatives: may help children gain some needed sensory input while still attending to the lesson(Fedewa, 2011; Washington, 2004).
- ii. Remove nuisance items
- iii. Allow for “escape valve” outlets.
- iv. Selectively ignore inappropriate behavior
- b. Classroom interventions(Harrison, 2009; Henderson, 2008; University, 2007)
 - a. Environmental and instructional considerations
 - i. Task difficulty
 - ii. Direct instruction
 - iii. Peer tutoring
 - iv. Class wide peer tutoring
 - v. Scheduling
 - vi. Novelty
 - vii. Structure and organization
 - viii. Rule reminders and visual cues
 - ix. Pacing of work
 - x. Clear and direct instructions
 - xi. Choice
 - xii. Productive physical movement
 - xiii. Active involvement
 - xiv. Planning ahead
 - xv. Cross modality responding and feedback
 - xvi. Distractions
 - xvii. Pointers: Teach the child to use a pointer to help visually track written words on a page.
 - xviii. Egg timers: An egg-timer is a device the primary function of which is to assist in timing the cooking of eggs. Early designs simply counted down for a specific period of time. Some modern designs can time more

- accurately by depending on water temperature rather than an absolute time ("Timer," 2015).
- xix. Classroom lights: Turning the classroom lights on and off prompts children that the noise level in the room is too high and they should be quiet.
- xx. Music: Play music on a tape recorder to prompt children that they are too noisy.
- xxi. Hurdle helping. Teachers can offer encouragement, support, and assistance to prevent students from becoming frustrated with an assignment
- b. Study skills
- i. Adapt worksheets: help a child fold his or her reading worksheet to reveal only one question at a time. The child can also use a blank piece of paper to cover the other questions on the page.
- ii. Venn diagrams: Teach a child how to use Venn diagrams to help illustrate and organize key concepts in reading, mathematics, or other academic subjects.
- iii. Note-taking skills: Anita Archer's Skills for School Success (Archer, 2002).
- iv. Checklist of frequent mistakes: Provide the child with a checklist of mistakes that he or she frequently makes in written assignments (e.g., punctuation or capitalization errors), mathematics (e.g., addition or subtraction errors), or other academic subjects. Teach the child how to use this list when proofreading his or her work at home and school.
- v. Checklist of homework supplies
- vi. Uncluttered workspace.
- vii. Monitor homework assignments
- viii. Test-taking strategies (Amarasinghe, 2010)
- ix. Implementation of individualized programs if the child does not respond to standard treatment, e.g., provision of one-to-one support, remedial and/or revision sessions, if appropriate (Amarasinghe, 2010).
- c. Contingency management: encouraging appropriate behavior
- i. Powerful external reinforcement
- ii. Self-monitoring
- iii. Time out
- iv. Token economy systems
- v. Response cost programs
- vi. Define the appropriate behavior while giving praise.
- vii. Give praise immediately
- viii. Vary the statements given as praise.
- ix. Be consistent and sincere with praise.
- c. Adaptation of daily routine - reasonably consistent, predictable and structured daily routines help children to self-regulate.
- d. Use of a visual timetable within the home and classroom environments. A visual timetable is a visual presentation of a daily schedule on a large piece of paper.
- e. Appropriate dimensions of chair and table to address poor postural control,

- i. If they are not, the child will be more inclined to squirm and fidget.
 - ii. A general rule of thumb is that a child should be able to put his or her elbows on the surface of the desk and have his or her chin fit comfortably in the palm of the hand.
- f. The selection of seating position to address potential ocular-motor deficits

- 1. Seat the child near the teacher
- 2. Seat the child near a student role model

1. Provide low-distraction work areas: Implementation of environmental manipulations (e.g., by seating the child away from distractions such as windows, doors and the back of the classroom)(Amarasinghe, 2010).

- g. The provision of a special device to aid efficient handwriting performance.

E. Mixed

- a. BI-PED: Brief Interventions: Pediatrics (M.D., 2007): Lists various strategies for managing individual behavior, homework issues and school accommodation
- b. Multicenter Evaluation of an Assessment and Treatment Package - family-centered occupational assessment and treatment package (R. F. Chu S, 2007) : The model recommends choosing from a number of evaluation procedures and intervention strategies, including environmental adaptation, training for parents and teachers, behavioral and educational management, the selection of appropriate tasks, and the remediation of sensory, perceptual-motor and functional difficulties. The

package lasts for 3 months, with a total of 12 weekly contacts with the child, parents and teachers.

- c. Multimodal interventions (Amarasinghe, 2010) - Indirect via parents, teachers and counselors and direct via the child.

Early intervention

A. The rationale for early intervention is that, we can identify early developmental phenotypes of ADHD, as phenotypes evolve during development. We need to keep in mind that environmental variations have the potential to influence brain and behavioral development and phenotypic expression so that casual pathways to ADHD associated with phenotypic expression are amenable to environmental manipulations.

B. Potentially Important Elements for Early Intervention(Sonuga-Barke, 2010)

In order to optimize their chances of success, our hypothesis is that early interventions should be initiated prior to the onset of severe symptoms. One has to target underlying 'casual' pathways and developmental processes to prevent or moderate the course of the disorder and precursor states and pathological processes. Also we should expand into the child's 'real life' to facilitate generalization (e.g., teachable moments). It should be developmentally appropriate and preferably intrinsically rewarding (i.e., fun) for preschoolers.

- C. Early Intervention that targets underlying casual pathways need to be developed to test if they can
 - reduce the likelihood of disorder emerging;
 - alter developmental trajectories;

- limit severity and/or persistence across the lifespan;
- diminish long-term burden associated with ADHD.

D. **Environmental** enrichment (Curchack-Lichtin, 2012), primarily in the form of neurocognitive enhancement and physical exercise, can be used to enhance neural development, which, in turn, will have an enduring impact on the trajectory of ADHD. Central to this notion are 2 hypotheses:

- a. changes in brain structure and function over the course of development are directly related to ADHD severity and the degree to which the disorder persists or remits with time; and
- b. neurocognitive enrichment and physical exercise can facilitate structural and functional brain development.

There may be many other types of interventions. But whenever it is to be used, we need to consider what is “*Levels of Evidence for Therapeutic Studies*” (A, 1995; Burns, Rohrich, & Chung, 2011; Petrisor & Bhandari, 2007). There will be some techniques which will require additional professional training. It might have to be sought before it is tried on the clients. One can contact with the corresponding author, go through the reference list of the articles or follow the professional guidelines of organization.

Level	Type of evidence
1A	Systematic review (with homogeneity) of RCTs
1B	Individual RCT (with narrow confidence intervals)
1C	All or none study
2A	Systematic review (with

Level	Type of evidence
	homogeneity) of cohort studies
2B	Individual Cohort study (including low quality RCT, e.g. <80% follow-up)
2C	“Outcomes” research; Ecological studies
3A	Systematic review (with homogeneity) of case-control studies
3B	Individual Case-control study
4	Case series (and poor quality cohort and case-control study
5	Expert opinion without explicit critical appraisal or based on physiology bench research or “first principles”

Take Home Message

Outcomes from behavioral interventions tend to be setting specific, so that behavioral interventions implemented in one setting (e.g., home) often do not generalize to another setting (e.g., school) without behavioral intervention in that setting as well. Although treatment effects can persist for at least several months after treatment ends, beyond that time, periodic treatment may be necessary. Although they are large, the effects from behavioral treatments may not achieve full normalization. Multicomponent treatments, which include parents, teachers, and child components, provide the most comprehensive approach and likely result in the greatest yield across all domains of difficulty for youth with ADHD (Pfiffner).

Yoga and regular massage therapy may reduce the severity of ADHD symptoms (Jensen PS, 2004; Lake, 2010).

Computerized Progressive Attentional Training (CPAT) Program showed significant improvement in nontrained measures of reading comprehension, and passage copying as well as a significant reduction of parents' reports of inattentiveness(Shalev et al., 2007).

Virtual Reality system is found to be effective in improving the attention and impulsivity of children with ADHD. Found greater improvements on completion time in Virtual Reality (VR) group than in non-VR group(Wang & Reid, 2011). Cognitive-behavioral modification could be integrated with VR capabilities (Wang & Reid, 2011).

Social skill training: Presently there is little evidence of its effectiveness. There is no statistically significant treatment effects either on social skills competences, teacher-rated general behavior, ADHD symptoms(Storebo et al., 2011). Social skills training plus parental training did not show any significant benefit for children with ADHD (Storebo, Gluud, Winkel, & Simonsen, 2012).

OT-SI (Occupational Therapy using Sensory Integration Frame of reference) may be effective in ameliorating difficulties of children with ADHD and Sensory Modulation Disorder (Miller, 2007).

A comprehensive individualized direct sensory integration therapy incorporating concepts of Alert Program® provided to the subjects, led to significant improvement self-regulation and social behaviors(Aishwarya Swaminathan, 2014).

Further research examining the effectiveness of family therapy versus a no-treatment control condition is needed to determine whether family therapy is an effective intervention for children with ADHD. There

were no results available from studies investigating forms of family therapy other than behavioral family therapy(Bjornstad & Montgomery, 2005).(Cochrane Review)

Parent training may have a positive effect on the behavior of children with ADHD. It may also reduce parental stress and enhance parental confidence. However, the poor methodological quality of the included studies increases the risk of bias in the results. Data concerning ADHD-specific behavior are ambiguous. For many important outcomes, including school achievement and adverse effects, data are lacking.Future research should ensure better reporting of the study procedures and results(Zwi et al., 2011).(Cochrane Review)

There is preliminary evidence for the effectiveness of mindfulness for children with ADHD and their parents, as rated by parents. However, in the absence of substantial effects on teacher-ratings, one cannot ascertain effects are due to specific treatment procedures.(Oord, 2011).

Aquatic therapy findings suggest that an exercise program that involves both quantitative and qualitative exercise characteristics facilitates the restraint inhibition component of behavioral inhibition in children with ADHD(Chang et al., 2014) .

Tai Chi appears to be associated with improvements in psychological well-being including reduced stress, anxiety, depression and mood disturbance, and increased self-esteem. Definitive conclusions are limited due to variation in designs, comparisons, heterogeneous outcomes and inadequate controls. High-quality, well-controlled, longer randomized trials are needed to better inform clinical decisions (Chenchen Wang1, 2010).

Use of therapy balls/ Swiss balls for students with ADHD may facilitate in-seat behavior and legible word productivity (News, 2015; Schilling, Washington, Billingsley, & Deitz, 2003).

Acupuncture (complementary and alternative medicine: CAM)(Li et al., 2011): Presently there is no evidence of its effectiveness for children with ADHD. (Cochrane Review)

Physical activity shows promise for addressing ADHD symptoms in young children (Smith et al., 2013).

“Giving Back,” by Karen “Freesia” Peterson, Hawaii. [For 2001-2002 and 2002-2003: Test results of children involved in a Brain Gym program where they were mentored by seniors showed a significant decrease in all problematical behaviors, including symptoms of attention deficit disorder and hyperactivity during the period of participation (“Freesia” Peterson, 2005).

As a result of the limited number of studies, the small sample sizes and the high risk of bias, it is difficult to draw any conclusions regarding the effectiveness of meditation therapy for ADHD. The adverse effects of meditation have not been reported. More trials are needed(Krisanaprakornkit et al., 2010).(Cochrane Review)

Programs developed to increase Effortful Control or trait-focused parent training for typically developing children may turn out to be also beneficial for children with ADHD(De Pauw & Mervielde, 2011).

Websites can be used as an adjunct to information given at clinic. Although a majority of parents will access them, there are still barriers to access e.g. time. Websites do seem to improve parent/carer knowledge levels (Ryan, 2015).

There is currently little evidence for the efficacy of homeopathy for the treatment of ADHD. Development of optimal treatment protocols is recommended prior to further randomized controlled trials being undertaken (Coulter & Dean, 2007).(Cochrane Review)

Free fatty acid supplementation and artificial food color exclusions appear to have beneficial effects on ADHD symptoms, although the effect of the former are small and those of the latter may be limited to ADHD patients with food sensitivities(Sonuga-Barke, 2013).

Ginkgo biloba(ginkgo), and *Hypericum perforatum*(St. John’swort) are ineffective in treating ADHD. The CAM natural products reviewed provide a mixture of results, with the most promising concerning minerals zinc and iron, and the antioxidant botanical French maritime pine bark. Mineral status and deficiency should always be a clinical consideration when treating children and adolescents with ADHD, however beyond addressing deficiency; it may be unlikely that a greater effect will occur from supplementation in those with a good diet. While the current omega-3 data are not supportive of its use in ADHD, future studies using higher dose preparations may reveal better effects, and regardless, can still be advised in cases of deficiency. Herbal medicines while presently under researched in this area may yet provide novel treatments of ADHD. Interventions involving combinations of herbal and nutritional medicines to address mineral deficiency, provide antioxidant and GABA-ergic effects, and those that modulate prefrontal cortex activity may be of benefit in this population (Sarris, Kean, Schweitzer, & Lake, 2011).

Evaluating and addressing peer rejection in treatment planning is necessary to improve long-term outcomes in children with ADHD. Peer rejection predicted cigarette smoking, delinquency, anxiety, and global impairment at 6 years and global impairment at 8 years after baseline. Having a reciprocal friend was not, however, uniquely predictive of any outcomes and did not reduce the negative effects of peer rejection (Mrug, 2012). Given the limited improvement typically obtained in treatment studies that use peer report measures as outcomes with ADHD samples and the well documented predictive validity of peer reports for later adjustment, the need for more intensive interventions and novel approaches to address the peer problems of children with ADHD is emphasized (Hoza, 2007).

Majority of ADHD boys experience persistent symptoms and functional impairments into early adulthood. Persistence of ADHD is associated with greater psychiatric comorbidity, familiarity and functional impairments (Biederman, Petty, Evans, Small, & Faraone, 2010).

In psychosocial interventions, effect sizes varied across the outcomes assessed, with meta-analyses reporting positive and significant effect sizes for measures of some areas of child impairment (e.g., social impairment) and small and more variable effect sizes for distal and/or untargeted outcomes (e.g., academic achievement) (Fabiano, Schatz, Aloe, Chacko, & Chronis-Tuscano, 2015).

Long-term outcomes for ADHD when left untreated were poor compared with non-ADHD, and that treatment of ADHD improved long-term outcomes, but usually not to the point of normalization.

The outcomes are

- Drug use/addictive behavior (use, abuse, and dependence on alcohol, cigarettes, marijuana, stimulants, or illicit drugs; age at first use; multiple substance use; gambling),
- Academic (achievement test scores, grade point average, repeated grades, years of schooling, degrees earned), and
- Antisocial behavior (school expulsion, delinquency, self-reported crimes, arrests, detainment, incarceration, repeat convictions).
- Social function (relationships, peer nomination scores, marital status, multiple divorces, activities, hobbies),
- Self-esteem (self-perception, suicide ideation, suicide attempts, suicide rate),
- Occupation (employment, military service, job changes, occupation level, socioeconomic status),
- Driving (accidents, traffic violations, license suspensions, driving record),
- Services use (justice system, emergency health care, financial assistance), - obesity outcomes.

These trends may reflect what is of most immediate interest to society in a given time period. Continued impairment in occupation despite treatment may reflect the cumulative effects of ADHD symptoms and dysfunctioning over the lifespan (Shaw, 2012).

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ⁱⁱSelf-regulation is a complex process requiring awareness of contextual demands, self-monitoring of one's behavior to evaluate whether it is appropriate for a context, and adjusting behavior when necessary Working Memory (WM) comprises a verbal and spatial capacitance (storage) function as well as a manipulating function (e.g., the ability to prioritize and organize information particularly moving from low stimulus to high stimulus environments). Spatial working memory (SWM) involves the temporary storage and manipulation of visuospatial (nonverbal) information that is necessary for a range of more complex cognitive functions.

ⁱⁱⁱ Time perception, which comprises multiple component processes, is an important function that facilitates the ability to predict, anticipate, and respond efficiently to coming events

^{iv}The phrase BRAIN GYM usually modifies a noun. Whether used by itself or as a modifying phrase, it describes a specific set of movements, processes, programs, materials, and educational philosophy. It is a registered trademark of the Educational Kinesiology Foundation (Brain Gym® International) in Ventura, California, USA.

^vAquatic exercise intervention that involves both aerobic and coordinative exercises

^{vi} "Meditation is a set of attentional practices leading to an altered state or trait of consciousness characterized by expanded awareness, greater presence, and a more integrated sense of self" (Davis 1998), which suggests that meditation might be a useful tool for attentional training in the ADHD population.

^{vii} Mindfulness training is an intervention based on eastern meditation techniques, which helps increasing awareness of the present moment, enhances non-judgmental observation, and reduces automatic responding (Kabat-Zinn 2003).

^{viii}Chiropractic is a health care profession that focuses on disorders of the musculoskeletal system and the nervous system, and the effects of these disorders on general health. Chiropractic care is used most often to treat neuromusculoskeletal complaints, including but not limited to back pain, neck pain, pain in the joints of the arms or legs, and headaches. Chiropractors have broad diagnostic skills and are also trained to recommend therapeutic and rehabilitative exercises, as well as to provide nutritional, dietary and lifestyle counseling. The most common therapeutic procedure performed by doctors of chiropractic is known as "spinal manipulation," also called "chiropractic adjustment."

^{ix}Neurofeedback (NF) is an operant conditioning procedure in which participants (patients) learn to gain self-control over EEG patterns (Heinrich et al. 2007). Measures representing these neurophysiological patterns are converted into visual or acoustic signals which are continuously fed back in real-time. Changes that are made in the desired direction are rewarded, i.e. positively reinforced. Neurofeedback training can be run as a kind of computer game and is thus principally attractive for children.

^x26 min of continuous moderate-to-vigorous physical activity daily over eight school weeks.

^{xi} The computerized progressive attentional training (CPAT) program is composed of four sets of structured tasks that uniquely activate *sustained attention*, *selective attention*, *orienting of attention*, and *executive attention*. Performance was driven by tight schedules of feedback and participants automatically advanced in ordered levels of difficulty contingent upon performance.

^{xii} Behavior therapy represents a broad set of specific interventions that have a common goal of modifying the physical and social environment to alter or change behavior.

^{xiii} According to the theoretical concept of Baddeley (2003, 2001) working memory (WM) consists of manipulation, maintenance, and storage of different types of material.

^{xiv}Cognitive-behavioral therapy (CBT) refers to a class of interventions that share the basic premise that mental disorders and psychological distress are maintained by cognitive factors. The core premise of this treatment approach, as pioneered by Beck

(1970) and Ellis (1962), holds that maladaptive cognitions contribute to the maintenance of emotional distress and behavioral problems. According to Beck's model, these maladaptive cognitions include general beliefs, or schemas, about the world, the self, and the future, giving rise to specific and automatic thoughts in particular situations. The basic model posits that therapeutic strategies to change these maladaptive cognitions lead to changes in emotional distress and problematic behaviors. Consistent with the medical model of psychiatry, the overall goal of treatment is symptom reduction, improvement in functioning, and remission of the disorder. In order to achieve this goal, the patient becomes an active participant in a collaborative problem-solving process to test and challenge the validity of maladaptive cognitions and to modify maladaptive behavioral patterns.

^{xv} Alert Program® based on Sensory Integration principles is a manualized program developed by Occupational Therapists, Mary Sue Williams and Shelly Shellenberger to develop self-regulation in children with many developmental disabilities including Autism, Learning Disability and Attention Deficit Hyperactivity Disorder. Alert Program teaches self-regulation to the "Alert team" (parents, teachers and children themselves) using — engine analogy. It teaches ways to monitor and maintain alertness levels required for a particular task or situation and thus improves self-regulation.