EXTERNALIZING THE EXECUTIVE FUNCTIONS IN WORKING MEMORY OF CHILDREN WITH ATTENTION DEFICIT HYPERACTIVE DISORDER

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Abstract

Around the globe, between 6 to 7 percent of children are diagnosed with ADHD, making it the most commonly diagnosed pediatric Neuro-developmental disorder. In India, ADHD is found to be a very under-researched topic. However, it does make learning difficult. Learning involves using the executive functions of the brain particularly the ability to focus, pay attention, engage with a task, and use working memory. This article will explain the effectiveness of externalizing the Executive Functioning of the Working memory of a child with ADHD. Various Intervention Strategies such as Yoga, Meditation, Cognitive Behavior therapy, Inclusive Classroom, and the introduction of Gamification in Academics can be used to create interest and Attention among children with ADHD. All the interventions act as Physical and Mental Stimulants. The inclusive setting paves way for assimilation and accommodation for Children with Attention Deficit Hyper-active Disorder. The heterogeneous group or the diverse learners in the inclusive classroom brings a change in the ADHD child, they try to adjust and be comfortable with their peers, and the teacher becomes a facilitator and teaches ADHD students using various strategies in the classroom. The teacher, student, and parent relationship becomes effective and is considered a golden triangle.

Keywords: *Attention Deficit Hyperactive Disorder, Working Memory, Executive Functioning, Intervention Strategies, Inclusive Classroom.*

Introduction

Attention Deficit Hyperactive Disorder is found to be approximately 3.4 % of the World population. Early in 1902 -1980 people perceived that ADHD is a behavioral problem. In 1980, it has been addressed as Attention Deficit Hyperactive Disorder. The Physical and Mental Stimulus is given as an external Executive Function to enhance the Working memory of the brain. The interventions can be given simultaneously to Children with ADHD with Medication and Without Medication. The achievement of the students can be diagnosed by the teacher in the school with certain parameters or through the Screening and Assessing of the working memory of ADHD students with the help of function MRI relating to the Cognitive-Neuroscience.

Literature Review

Pawan Sharma et al. (2020) undertook a study on rural school children in North India. The study focused on identifying the prevalence of ADHD among children with ADHD in age-group 6–12 years studying in Jammu district Government schools. The samples were randomly selected from the government primary schools in the zone using the survey method. Vanderbilt ADHD diagnostic teacher rating scale was used to assess the prevalence of ADHD. The investigator visited the residence of the samples to collect the personal information from the parents especially the mothers using a personal information questionnaire (PIQ) presented as proportions. Results: Prevalence of ADHD was 6.34% (13/205). ADHD-positive children mostly belong to joint families and are of lower and lower-middle class. (69.3%). There was no existence of a Family history of ADHD found in ADHD children. The study elicits that ADHD children of age group 6 to 12 years from rural areas studying in Government school of J&K district was found to have a 6.34% of a high prevalence of ADHD.

Renz Anthony Supangan et al. (2019) conducted a study relating to Gamified Learning by creating an App for Children with ADHD. The researchers have used an Android mobile having various applications in it. These applications are used as a teaching resource for children with ADHD in various school subjects. The application used by the researcher seems to be an Interactive E-learning System for children with ADHD. User Acceptance Test was conducted by the researcher in a local public elementary school with the help of the school's SPED teachers. The teachers answered the UAT questionnaire so they could justify the contents of the application and ensure whether it is appropriate for children with ADHD. SPED Teachers are satisfied and ready to execute the E-learning application. The teachers agree that gamification is interesting and is also easy to use and can be an effective tool for teaching and learning.

Beyin et al. (2018) have conducted a study on the Effects of yoga and its principles in Asanas. Where Pranayama and Meditation play a major role in the Brain Waves. Yoga is a physical exercise involving physical movements (asana), breathing exercises (pranayama), and meditation for concentration and it reduces stress and anxiety. Yoga has got all kinds of remedies for all ailments. It plays a major role in cardio respiratory, metabolic, and physical effects in the human body IT improves cognitive abilities and has also been proven clinically. This review study is to explore the effects of yoga on neurons in the brain. It states that activation of alpha, beta, and theta waves can be induced by asana, pranayama, and meditation. It gains positive effects on the perception of a person with good memory. The study recommends that different yoga styles be followed for the neurological problems in an individual. It also specifies to design of yoga practices and programs for various neurological and brain disfunction.

Anup De., Samiran Mondel, (2016) has critically analyzed the improvement of brain function by practicing yoga and meditation as intervention along with breathing practice

pranayama. yoga includes asanas and breathing exercises (pranayama) along with meditation or the state of dhyana. yoga is a set of simple exercises which involves the body and mind of a person. Yoga has an effective impact on mental and physical activity. It also improves the activities of the brain. The study aims to find related scientific Literature on yoga and brain function. The researcher has collected scientific data from internet resources such as ROAJ, DOAJR, Web of Science, Google Advanced Search, PsycINFOPubmed, Embase, Medline, Google Scholar,.yogic practices along with meditation improve memory in students. The psychic disorder can be improved by Meditation. Pranayama or the breathing practice may be used as an intervention for stress and anxiety. Brain activity and other neuro-cognitive functions can be improved by practicing Yoga and meditation.

Marko Wilke, MD, (2016) conducted a study on Functional magnetic resonance imaging in pediatrics. The researcher has discussed neural activation and the local cerebral blood flow. The change in the blood flow or the increase in the blood flow can be detected using the MR technique which has a magnetic field in it to detect the sensitive changes in the neurons. The technique used is "blood oxygenation level-dependent" (BOLD) Blood in the brain is used as the contrast medium. BOLD imaging shows the magnetization effects resulting in oxygenated and deoxygenated hemoglobin flow in the brain activity. Neural activation is stimulated resulting increase in blood flow. Oxygenated hemoglobin is found in the venous capillaries within the brain parenchyma which shows the difference in the image due to the capillary density in gray matter. The minute distortions in the magnetic field are noticed on the order of 1–4%. The effect in gray matter is found to be more and provides the overall signal. The study concludes that an fMRI study can be done for children and a few problems in the application are also discussed.

Michael C. Stevens et al. (2015) conducted a study on the after-effects of working memory training on the functioning of the brain. The present study is to find out whether WM training could bring any change in the brain function of ADHD adolescents, To examine the clinical improvement in a sample of 18 adolescents diagnosed with DSM-IV were taken as sample for the study. WM training was given for 25 sessions by (Cogmed™) approach, Sternberg's nonverbal WM fMRI was taken, along with parent report and neuropsychological tests, which were used to analyze the prevalence of ADHD in adolescents. SPM8 brain analyses are used to identify ADHD in the adolescent samples. when compared to a non-ADHD adolescent sample of the 18control group, and tested for brain activation in the frontoparietal lobe for an increase in activation after the WM training. Post-tests show connectivity in the neural functions and neurocognitive developments. WM training and ADHD clinical functioning may increase WM performance. WM-related brain activity was found in frontal, parietal, and temporal lobes regions. In all Encoding, there was an increase in the activity of the left inferior frontal sulcus region. Improvements in the working Memory of ADHD have improved and correlated with

activation in brain regions related to executive functioning. Improvement of different symptoms in the ADHD samples had different neural correlates.

Need and Significance of the Study

ADHD is not a behavior problem but is a far more deficiency in the management of the brain system. ADHD is nothing to do with how smart a person is? It is a set of a problem with a wide range of characteristics, relating to what is involved in the brain. While trying to attend work, they are on and off in the activity, they get distracted. They lack focus on a particular work. It is wired in such a way in the Brain of ADHD, If something is interesting they pay attention. ADD cannot involve inactivity, if it is not interesting for them, whereas a normal person can be involved in an activity even if he or she is not interested in that activity. For a child with ADHD participation in an activity is under voluntary control he or she cannot make it with willpower. They tend to have difficulty starting an activity and difficulty getting to sleep. They lack in putting their ideas in paragraphs and writing even though they think intellectually. Difficulty in managing emotions is also a major problem found in Children with ADHD. If this emotional problem is not addressed by early Intervention it leads to anger in adults in a later stage, thus the individual is not able to cope with the society and family members or their life partners and ends up with a lack of interpersonal skills. The social circle of a child is closely linked with family, friends, and society. Special children must first get adjusted to one's self and then to the environment. This study is especially concentrated on the self-regulation of children with ADHD. To face day-to-day life one has to adapt to various adjustments such as social, classroom, emotional, peer, and academic adjustments. When such adjustments are incorporated among special children, they are successful in inclusive and mainstream schools. Teachers are now in a critical position since they need to involve the parents in bringing up ADHD children. Schools have started to initiate programs to encourage parent participation in their children's education. Parent-teacher collaboration plays a major role in ADHD students' success. Parents' involvement and collaboration with teachers may lead to scholastic achievement in ADHD children. Parental partnership with ADHD children will produce positive outcomes for both schools and families

Functioning of an ADHD Brain

Low levels of Norepinephrine, a neurotransmitter associated with Dopamine, are found in the ADHD brain. Dopamine is a neurotransmitter that regulates the reward and pleasure centers of the brain. In the ADHD brain, neurotransmitter activity is reduced in four functional regions, including the Frontal Cortex, which governs high-level functions like attention, executive function, and task organization. The Limbic System manages a person's emotions and attention. The Basal Ganglia comes next, where a deficiency causes the inter-Brain Communicator and Information to short circuit, resulting in inattention and impulsivity. The last is the Reticular Activity System is the pathway that enters and exit the

Brain. A Deficiency in Reticular Activity System can lead to inattention, impulsivity, or Hyperactivity. ADHD is a performance disorder and not a knowledge disorder. ADHD is a disorder of inhibition, that disrupts the executive system and leads to fear of self-regulation, which will delay the preparation of an individual to organize his daily activities to reach his future goals. Children with ADHD have much difficulty resisting distraction that shatters the Working Memory Function. WM has got the major executive ability, when the Executive function of the Children are disturbed where they cannot rearrange themselves to self-regulate and finish their task they end up with Executive Function Disorder. ADHD is also identified as Executive Function Deficit Disorder or Self-Regulation Function Disorder.

An fMRI Study

An fMRI study is executed to detect task and sensory triggered regional brain activity. The fMRI scan taken before and after the intervention would give scientific proof of the effectiveness of the Interventions. The results of the investigation will be useful for the children with ADHD to equip and establish their working memory to execute their Executive Functions in the brain. Functional Magnetic Resonance Imaging is an advanced technique for measuring and mapping brain activity. This can be adopted to find the nature of brain activation in children with ADHD.

Children with ADHD feel they cannot excel in academics. As they are not concentrating much on social mobility due to co-morbidities of ADHD. To overcome the problems various interventions can be introduced. Specific Intervention strategies such as Yoga, Meditation, Cognitive Behavior therapy, Inclusive Classroom, and introduction of Gamification in Academics can be used to create interest and improve the working memory of children with ADHD. The interventions bring insight into the understanding of the children with behavioral problems.

Yoga and Meditation

Multimodal intervention can be used as the gold standard for ADHD treatment, but it seems to be cost-effective. Whereas Intervention such as Yoga and Meditation is a kind of complementary intervention. Yoga can be used as a therapy for some time. The physical postures or the āsanas along with breathing exercises called the Prāṇ āyāma along with or without Medication. Yoga and meditation comprehensively improve the physiological functions along with the cognitive domains such as executive functions, attention, intelligence, memory, and concentration. Yoga and Meditation based interventions are effective in the management of co-morbid disorders such as anxiety, neuroticism, obsessive-compulsive disorder, and depression found in children with ADHD. Pranayama practiced for ADHD children are kapalabhati-Backward and forward bending, jogging Suryanuloma-Spinal twist, Candranuloma-Jumping, Mukhadhauti to relax, and Ujjayi- Cycling –Forward and backward. Yogasanas such as Tadasana and its variation, Ardhakaticakrasana, padahastasana, vajrasana, Suptavajrasana, Ustrasana, Marjaryasana, Sasankasana,

Pascimottanasana, Sarvangasana, Halasana, Matsyasana, Bhujangasana, Pavanamuktasana, Setubanddhasana, Savasana which ends with Omkara Chanting. The major problem faced by the psychiatrist, teachers, and parents when recommending yoga for a child with ADHD is how far they are cooperative, concentrate, learn and practice yoga.

Cognitive Behaviour Therapy

CBG can be used as an intervention for children with ADHD to focus on the present situation and avoid the disruptive thought process that has a negative influence on behavior. There are numerous types of Cognitive behavior therapy such as Dialectical behavior therapy (DBT) helps to regulate emotions and mindfulness, and Rational emotive behavior therapy (REBT) to identify irrational beliefs and change the thinking pattern in children with ADHD. Cognitive Behavioural Therapy can unravel the Cognitive distortions among children with ADHD. CBT can be given for the short term, it is goal-oriented and a form of psychotherapy used to enhance self-esteem, and thinking patterns and execute the function of the brain effectively and positively. Understanding the way we think is an effective start to making life changes, Change in thoughts will bring behavior change.CBT helps to develop learning ability and life skills. Planners to do the task, cognitive restructuring helps to identify the Catastrophize, Overgeneralize and mind read with guided discovery, CBT helps to replace negative self-talk with positive messages of self-compassion. Positive self-talk helps to feel encouraged and motivated to attain goals or complete tasks. Successive approximation helps to break tasks into smaller tasks and do them effectively. Creating workspace without disturbance or distraction, Set Time limits or alarms to complete the task, Taking regular breaks in between the tasks, having a perfectionist belief in self.

Gamification

Gamification is a series of activities that use the features of game elements to address problems. In the sphere of education, gamification is becoming increasingly popular. In other words, it 'makes learning more fun,' motivating pupils and making them feel interested and engaged in the subject. Gamification in learning can use game-based aspects like point scoring, peer competition, teamwork, and score tables to increase student engagement and help them assimilate new information and put their knowledge to the test. Gamification can be employed in a variety of ways, including at school and as self-learning apps. It elicits genuine, strong human emotions like joy, intrigue, excitement, and accomplishment. Institutions all across the world have begun to use gamification, with fantastic results. Educators may investigate and improve it for the development of Children with ADHD. Gamification helps to create interest and attention in the given task.

Selected units from the curriculum shall be designed and thought in Digital mode by gamification strategy. Evaluation will be done in the process of Quizzes, games, and Puzzles, the scores are rewarded immediately as gold, and platinum coins which may be the key to

playing the next level. Narrative, feedback, and Fun elements can be used in the classroom to motivate ADHD children. “Scaffolded learning” can be progressed using indicators such as stars pinned up, points, badges, and leader boards. Gamification in the classroom for children with ADHD results in autonomy in learning, Many trials are permitted so that the student is relaxed without anxiety and fear, and Children experience abundant fun in the classroom, Learning is visible through progress indicators, Students acquire intrinsic motivation while performing a task. Higher engagement and concentration levels could be found in ADHD children.

Inclusive Classroom

A whole-school approach is necessary for the success of students with ADHD. The teacher is the responsible person for the overall curricular experiences of students with ADHD in the classroom. Students with ADHD lack abilities for metacognition, they have difficulty activating, organizing, planning, integrating, and managing cognitive functions. Children with ADHD can be identified using the various techniques to provide necessary intervention and academic strategies with visual aids and schedules, communication with parents and the use of regular positive reinforcement in the classroom, academic strategies, students with characteristics of ADHD will be carefully and strategically partnered with students with positive learning habits and behavior. Brainstorming Activity for the brain to enhance their executive function in their working memory. Children with ADHD will be self-regulated and be attentive in class after the interventions. The support staff is vital to the support of students with diverse learning needs, such as those with ADHD.

Recommendations

- Pre-service training programs for teachers related to ADHD
- Special education course to be introduced in the pre-service program
- Universal Design for Learning, a specialized curriculum could be framed for children with ADHD
- Remove the barriers and facilitate an inclusive environment and classroom community
- Facilitate Diagnosis in schools with psychiatrists and counselors

Conclusion

Streamlining the behavior of ADHD children in the present scenario is a challenging task for the parents and Teachers. Externalizing the executive Functions in the Working memory of ADHD children through Interventions may help them to manage their academic and behavioral needs. The introduction of an inclusive setting helps for executing the executive Functions in the Working memory of ADHD, it provides insight into, their behavioral and academic problems. Effective intervention and externalizing the function of executive memory are to be provided to overcome the learning difficulties and behavioral

problems of ADHD children. The involvement of parents and teachers can be a supportive factor for enhancing the effective intervention strategies for children with ADHD. The interventions will create awareness and be mindful of the development of ADHD children and a key pioneer in the field of ADHD and it will help the children to stimulate their worried brains. Therefore, it will activate the executive functions in working memory at the time of doing any kind of activity and improvise the short-term memory. This study is also helpful for the various responsibilities in the field concerns such as the policymakers, Administrators, curriculum framers, teachers, parents, and other stakeholders for effective concentration in taking the proper intervention and memory-related pedagogical approaches. Intervention increases the self-confidence level and minimizes the co-morbidities that automatically lead to more academic performance and enhances the mental and social well-being of children with ADHD.

References

1. Anna-Maria Landolfi., (2014) Inclusive Classroom Communities: Supporting Students with Characteristics of Attention Deficit Hyperactivity Disorder retrieved from https://tspace.library.utoronto.ca/bitstream/1807/67035/1/Landolfi_Anna-Maria_201406_MT_MTRP.pdf
2. Anup De., Samiran Mondel, (2016). Improvement of brain function through combined yoga intervention, meditation, and pranayama: A critical Analysis *European Journal of Physical Education and Sport, 2016, Vol. (13), Is. 3. ISSN: 2310-0133 E-ISSN: 2310-3434,* DOI: 10.13187/ejpe.2016.13.89 www.ejournal7.com.
3. Arman Syah Putra, et al (2018) Gamification in the e-Learning Process for children with Attention Deficit Hyperactivity Disorder (ADHD), *INAPR International Conference,* Indonesia DOI: 10.1109/INAPR.2018.8627047
4. Arunachalam. N., & Sri R. Gopal., (2010) Special Education Self Instructional Module on Behaviour Disorders., A.P.H. Publishing Corporation, New Delhi.
5. Barkley, R. A. (2006). Attention-Deficit Hyperactivity Disorder: A Handbook for Diagnosis and Treatment (3rd ed.). New York: Guilford Journal of Attention Disorders 11(2):179-180 DOI: 10.1177/1087054707305334
6. Betti Stanco Vitanza., (2014). Attention-Deficit Hyperactivity Disorder: Teachers' Perceptions and Acceptability of Interventions, PCOM Psychology Dissertations, Paper315.Recommended citation Philadelphia College of Osteopathic Medicine.
7. Beyin, (2018) Effects of yoga principles (Asana, Pranayama, and Meditation) on Brain Waves. *Turkish Medicine of Sports Medicine,* Issue: 2018, Volume 53, Issue 2, Page: 089-093 DOI: 10.5152/tjsm.2018.095
8. Braswell, L., & Bloomquist, M. L. (1991) *Cognitive-behavioral therapy with ADHD children: Child, family, and school interventions.* Guilford Press.
9. Daniel Eisenberg and Helen Schneider., (2007) Perceptions of Academic Skills of Children Diagnosed with ADHD, *Journal of Attention Disorders,* 10(4) 390-397.

10. Davies S, D Hall., (2005) ‘‘Contact A Family’’: professionals and parents in partnership. Arch Dis Child 2005;90:1053–1057. DOI: 10.1136/adc.2004. 070706. Retrieved from: www.archdischid.com
11. Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (4th Edn) 1994, American Psychiatric Association: Washington DC, Pg 78,85.
12. Du Paul et al. (2006). The relative efficacy of two consultation-based models for designing academic interventions to enhance the educational functioning of children with ADHD. International Journal of Disability, Development, and Education, 53(2), 161-176.
13. Hariprasad V. R., et al (2013) Feasibility and efficacy of yoga as an add-on intervention in attention deficit-hyperactivity disorder: An exploratory study *Indian J Psychiatry*, DOI: 10.4103/0019-5545.116317
14. Holst J., (2007) Danish teacher's conception of challenging behavior and DAMP/ADHD. Early Child Development and Care, 178,4,363-374.
15. Johny Kutty Joseph,et al., (2019) Prevalence of attention-deficit hyperactivity disorder in India: A systematic review and meta-analysis. .*Indian Journal of Psychiatric Nursing, Volume : 16,Issue : 2* Page : 118-125 DOI: 10.4103/IOPN.IOPN_31_19
16. Joni Holmes et al., (2014) Children with low working memory and children with ADHD: same or different? *Frontiers in Human Neuroscience* v.8; DOI: 10.3389/fnhum.2014.00976.
17. Katya Rubia (2018) Cognitive Neuroscience of Attention Deficit Hyperactivity Disorder (ADHD) and Its Clinical Translation*, Frontiers in Human Neuroscience, Vol 12,* DOI: 10.3389/fnhum.2018.00100
18. *Kim C. M. Bul et al., (2018)* A serious game for children with Attention Deficit Hyperactivity Disorder: Who benefits the most? *https://doi.org/10.1371/ journal.pone.0193681*
19. Marko Wilke, MD,(2016) Functional magnetic resonance imaging in paediatrics , *Neuropediatrics,* 34(5): 225–233.doi: 10.1055/s-2003-43260
20. Michael C. Stevens et al., (2015) A preliminary study of the effects of working memory training on brain function. *Brain Imaging and Behavior* 10:387–407. DOI 10.1007/s11682-015-9416-2 # Springer Science+Business Media New York.
21. Pawan Sharmaet al., (2020) Prevalence and correlates of Attention Deficit Hyperactive Disorder (ADHD) risk factors among school children in a rural area of North India, *Journal of family medicine and Primary Care.* Vol : 9,(1) Pg -115-118*,* DOI: 10.4103/jfmpc.jfmpc_587_19
22. Renz Anthony Supangan et al (2019) A Gamified Learning App for Children with ADHD. Association for Computing Machinery.ACM ISBN 978-1-4503-6092-0/19/02 Retrieved from .https://doi.org/10.1145/3313950.3313966

23. Soccalingam, et.al, (2019). Yogic tools for special children. Retrieved from https://www.researchgate.net/publication/333852464
24. Solanto, M. V et al., (2010) Efficacy of meta-cognitive therapy for adult ADHD. *The American journal of psychiatry*, *167*(8), 958–968. https://doi.org/10.1176/appi.ajp.2009.09081123
25. Sree Kumar, et.al, (2015) Diseases and its cure through the great yogas study. *International Journal of Medical and Health Research,* Volume 1, Issue, ISSN: 2454-9142
26. Steven A. Safren, et al., (2005) Cognitive-behavioral therapy for ADHD in medication-treated adults with continued symptoms, Behaviour Research and Therapy, Volume 43, Issue 7, 2005, Pages 831-842, ISSN 0005-7967, https://doi.org/10.1016/j.brat.2004.07.001.(https://www.sciencedirect.com/science/article/pii/S0005796704001366)
27. Thawatchai Krisanaprakornkit et al.,(2010) Meditation therapies for attention-deficit/hyperactivity disorder (ADHD) retrieved from Pubmed.gov DOI: 10.1002/14651858.CD006507.pu
28. TorkelKlingberg, et al.,(2002) Training of Working Memory in Children With ADHD, *Journal of Clinical and Experimental Neuropsychology* Vol. 24, No. 6, pp. 781±791, DOI: 10.1076/jcen.24.6.781.8395 Source: PubMed: https://www.researchgate.net/publication/11041372