

EFFECT OF SENSORY INTEGRATION THERAPY AND COGNITIVE BEHAVIORAL THERAPY ON ATTENTION DEFICIT HYPERACTIVITY DISORDER: SINGLE BLINDED STUDY

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ABSTRACT

Introduction: Attention deficit hyperactivity disorder (ADHD) is a neurobehavioral developmental disorder. Cognitive behavior therapy is effective in children with ADHD. But data are lacking to prove efficacy of sensory integration therapy in treating the children with ADHD.

Method: This multi-center experimental study was done at three physiotherapy colleges in India. 60 patients with ADHD are included in the study. They are randomly assigned into three different groups. Group A: 20 (subjects receiving sensory integration therapy), group B: 20 (subjects receiving cognitive behavior therapy) and group C: 20 (subjects receiving sensory integration therapy and cognitive behavior therapy). The outcome measure used is Conner's Teacher Rating Scale before and after six months of intervention.

Result: There was a significant decrease in scores of Conner's Teacher Rating Scale ($p < 0.001$) in children with ADHD who received sensory integration therapy and Cognitive Behavior Therapy alone and combined therapies of Sensory Integration Therapy and Cognitive Behavior Therapy.

Conclusion: Combined therapies of Sensory Integration Therapy and Cognitive Behavior Therapy are effective in reducing symptoms of ADHD as assessed by Conner's Teacher Rating Scale.

KEY WORDS: Attention Deficit Hyperactivity Disorder, Cognitive Behavior Therapy, Sensory Integration Therapy.

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INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a neurobehavioral [1] developmental disorder [2]. ADHD is primarily characterized by the co-existence of attention problems and hyperactivity, with each behavior occurring infrequently alone [3].

ADHD is the most commonly studied and

diagnosed as psychiatric disorder in children affecting about 3 to 5% of children globally with symptoms starting before seven years of age [4,5]. Srivastava et al marked 1% of ADHD prevalence in the total general population in India, whereas 3-3.5% of children may be diagnosed to suffer from ADHD [6].

Though previously regarded as a childhood

diagnosis, ADHD can continue throughout adulthood [7]. 4.7 percent of American adults are estimated to live with ADHD [8]. ADHD is diagnosed two to four times as frequently in boys as in girls though studies suggest this discrepancy may be due to subjective bias of referring teachers [9].

The pathophysiology of ADHD is unclear and there are a number of competing theories.¹⁰ Research on children with ADHD has shown a general reduction of brain volume, but with a proportionally greater reduction in the volume of the left-sided prefrontal cortex [11]. In one study a delay in development of certain brain structures by an average of three years. The delay was most prominent in the frontal cortex and temporal lobe, which are believed to be responsible for the ability to control and focus thinking. In contrast, the motor cortex in the ADHD patients was seen to mature faster than normal, suggesting that both slower development of behavioral control and advanced motor development might be required for the fidgetiness that characterizes ADHD [12].

The neurotransmitters dopamine (DA) and norepinephrine (NE) are implicated in the pathophysiology of ADHD. Dopamine is a neurotransmitter involved in reward, risk taking, impulsivity, and mood. Norepinephrine modulates attention, arousal and mood. Brain studies on individuals with ADHD suggest a defect in the dopamine D4 (DRD4) receptor gene and over expression of dopamine transporter-1 (DAT1). The DRD4 receptor uses DA and NE to modulate attention to and responses to one's environment. The DAT1 or dopamine transporter protein takes DA/NE into the presynaptic nerve terminal so it may not have sufficient interaction with the postsynaptic receptor [13]. Some study also found involvement of the "7-repeat" variant of the dopamine D4 receptor gene, which accounts for about 30 percent of the genetic risk for ADHD, in unusual thinness of the cortex of the right side of the brain; however, in contrast to other variants of the gene found in ADHD patients, the region normalized in thickness during the teen years in these children, coinciding with clinical improvement [14].

Single Photon Emission Computed Tomography (SPECT) scans found people with ADHD to have

reduced blood circulation (indicating low neural activity) [15], and a significantly higher concentration of dopamine transporters in the striatum which is in charge of planning ahead [16,17].

In 1990, Zametkin et al [18] compared positron emission topography (PET) scans of adults with and without ADHD. Global and regional glucose metabolism was reduced in adults who had been hyperactive since childhood. The largest reductions were in the premotor cortex and the superior prefrontal cortex. This was the first functional neuroimaging study to indicate brain differences in individuals with ADHD.

The causes may include and not limited to genetic factors, environmental factors, brain injuries, diet, food additives, social factor, and toxins. Inattention, hyperactivity and impulsivity are the key behaviors of ADHD [19-24]. It can be diagnosed by Brain imaging, such as functional MRI, SPECT scans, PET scans or CT scan are useful tools. For differential diagnosis laboratory tests includes liver function test and thyroid function test are useful. Psychological tests include DSM-IV, ICD-10; both of them based on symptoms and behaviours. There are also questionnaires and scales useful for the diagnosis, like the Conners Parent-Teacher Rating Scale, Barkley Home Situations Questionnaire or the Wender Utah Rating Scale for adults may be useful [25-28].

The most commonly used diagnostic criteria used in the United State is the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). The DSM-IV criteria have different symptoms for inattention and hyperactivity. All of the symptoms must be present for at least 6 months and must reach at least six of the nine criteria in the category. The other conditions which must be present for diagnosis of ADHD is that must appear before age seven, must be present in two or more settings, there must be clear evidence of clinically significant impairment in social, academic, or occupational function, and symptoms do not occur during the course of another psychotic disorder, and lastly are not better accounted for by another mental disorder (American Psychiatric Association, 1994) [26].

The Conner's Teacher Rating Scale (CTRS) is one of the most popular rating scales used by

professionals today for teacher rating scales to diagnose ADHD. The Conner's Teacher Rating Scale-39 (CTRS-39) contains 39 items wherein frequency of behavior is rated on a 4-point Likert scale ranging from not at all (0) to very much (3) [27]. This scale covers children from ages 3 to 17. This rating scale has adequate psychometric properties and has been widely used for clinical and research purposes with the ADHD population [28]. The CTRS scales have well-established reliability, validity and clinical utility. The major purpose of the CTRS is to provide information at a screening level to assist clinicians and researchers such information is considered a necessary part of the process of assessment, diagnosis and treatment monitoring [29].

Methods of treatment often involve some combination of behavior modification, life-style changes, counseling, and medication. A 2005 study found that medical management and behavioral treatment is the most effective ADHD management strategy, followed by medication alone, and then behavioral treatment. While medication has been shown to improve behavior when taken over the short term, they have not been shown to alter long term outcomes [30].

Psychological therapies used to treat ADHD include psycho educational input, behavior therapy, cognitive behavioral therapy (CBT), interpersonal psychotherapy (IPT), family therapy, school-based interventions, social skills training and parent management training [31]. A review by Jensen et al concluded that the evidence is strong for the effectiveness of behavioral treatments in ADHD [32].

Management with medication has been shown to be the most cost-effective, followed by behavioral treatment and combined treatment in a 14 month follow-up study [30]. However, a longer follow-up study of 3 years found that stimulant medication offered no benefits over behavioral therapy [33]. Stimulants are the most commonly prescribed medications for ADHD. Atomoxetine is currently the only non-stimulant drug approved for the treatment of ADHD [34].

Sensory Integration (SI) therapy has a neurophysiologic approach to behavior that applies to and can improve hyperactivity and attention problems. Dr. Jean Ayres developed the

theory behind sensory integration therapy. The therapy does not directly work on functional skills, but rather it focuses on providing sensory input to help organize the central nervous system. Through this sensory input, underlying sensory processes are theoretically normalized with the assumption that improvement in sensory processing will lead to observable improvements at the functional level [35].

METHODS

This multi-center experimental study was conducted in three physiotherapy colleges in India and was approved by institutional ethical committee of individual colleges. The subjects were screened based on ADHD diagnosed with DSM IV criteria and voluntary decision to participate in the research was consented by parents after explaining about the procedure of the study. Subjects between 4 and 6 years of both genders were included in the study. Physical disability including hearing or vision, hypothyroidism, mental retardation or associated psychological disorders like conduct disorder, mood disorder, bipolar and anxiety disorder were excluded for this study. Subjects who are on medication for ADHD and score more than 100 in Conner's teacher rating scale were also not included for study. The eligible subjects were randomly allotted in to group A, group B and group C, randomization was done by using closed envelop method at the first author's setting.

All subjects were randomly divided into Group A (SIT group), Group B (CBT group) and Group C (Combined group). All selected subjects were assessed with Conner's teacher rating scale [27-29] before and after intervention by the teachers of individual participants.

Group A subjects were treated with SIT including tactile (brushing), vestibular (swing, rolling, spinning), proprioception (bouncing on trampoline or large ball, pushing activities, playing with weights), auditory (sing-songs, loud and slow noise) and visual (focusing, following and tracking) input. The session was for one hour per day for 5 days per week.

Group B subjects were treated with CBT which includes self instruction training and problem solving approach with dialogues, games and

activities. Self instruction training makes use of internal dialogue or self talk that will guide the child's cognitive process and overt behavior. Self instruction treatment regime was consisting of following steps. The physiotherapist was model, talking aloud while performing the task and the child performed same task while therapist was providing verbal instruction. The child was asked to perform the task again while instructing him or herself aloud, using statements similar to those, modeled by the physiotherapist. The child was asked to perform task while whispering to him or herself, using no loud but only lip movement and at last the child was asked to perform task while verbalizing covertly without lip movement.

Problem solving approach included dialogues and activities with instruction. The components of the problem solving approach were, initial inhibition of impulsive responses (stop and think), problem identification, generating alternatives, evaluating consequences, making plan and evaluating the effectiveness of the initially chosen solution and selecting a backup plan (reward). Above components were taught to the child to complete the activities and to solve the social problems. The session was for one hour per day for 5 days per week.

Group C was treated with SIT and CBT as discussed above for 30 minutes each per day for 5 days per week. All three groups received intervention as per their group allotment for six months.

Data Analysis

The data were analyzed by using Statistical Package for Social Sciences Version 17 with descriptive analysis, Wilcoxon Signed Rank Test for within group difference, Kruskal Wallis Test for between group difference and Mann Whitney U test for paired comparisons in significant cases with level of significance set at p value less than 0.05. Figure 1 and 2 shows the age and sex distribution of participants in the study.

Fig. 1: Age distribution among groups.

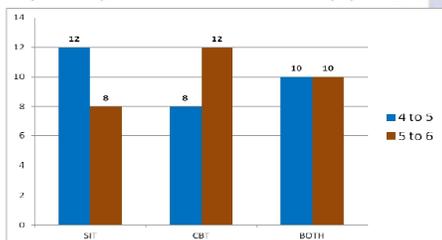


Fig. 2: Sex distribution among groups.

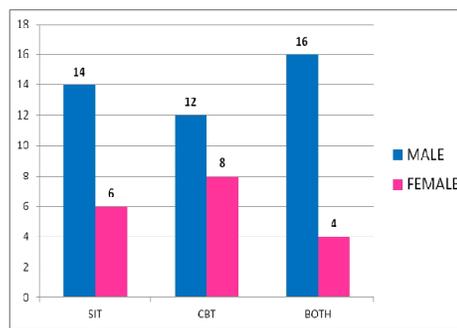


Table-1: Comparison with in the group by using Wilcoxon Signed Rank Test.

Group	Pre treatment		Post treatment		z-value	p-value
	Mean	SD	Mean	SD		
SIT	71.3	15.485	66.1	14.019	2.67	0.008
CBT	73.9	11.1	66.7	9.719	2.807	0.005
Combined	70.8	10.973	47.5	5.338	2.807	0.005

The above table shows the mean, standard deviation (SD), z-value and p-value of all three groups before and after intervention by using Wilcoxon Signed Rank and descriptive analysis. The mean ± SD before intervention in SIT group is 71.30 ± 15.485, in CBT group is 73.90 ± 11.100 and in BOTH group is 70.80 ± 10.973. After intervention in SIT group is 66.10 ± 14.019, in CBT group is 66.70 ± 9.719 and in BOTH group is 47.50 ± 5.338. All three groups are showing statistically significant improvement with p value less than 0.01 in Wilcoxon signed rank test

Fig. 3: Mean values of all three groups before and after intervention.

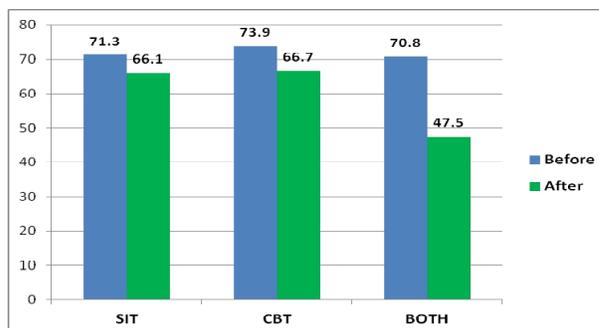


Table 2: Kruskal Wallis test ranks and statistics.

Intervention	Group	Mean Rank	Chi-Square value	p value
Before	SIT	14.8	0.638	0.727
	CBT	17.3		
	Combined	14.4		
After	SIT	19.3	14.415	0.001
	CBT	20.3		
	Combined	6.9		

The table-2 shows the ranks and statistics of Kruskal Wallis test for inter group comparison. Before intervention chi-square value is 0.638 with p value more than 0.01 showing that all three groups are homogenous at baseline. After intervention the mean rank for SIT group is 19.30, CBT group is 20.30 and Combined group is 6.90 with chi square value is 14.415 and p value equal to 0.001 showing that there is statistically significant difference. So paired group comparisons of SIT Vs CBT, SIT Vs Combined and CBT Vs Combined were done by using Mann Whitney U Test.

Table 3: Mann Whitney U Test for independent paired comparisons.

Groups	Mean Ranks	Sum of Ranks	z value	p value
SIT	10.4	104	0.076	0.94
CBT	10.6	106		
SIT	14.4	144	2.956	0.003
Combined	6.6	66		
CBT	15.2	152	3.556	0
Combined	5.8	58		

Table-3 shows independent paired comparisons of all three groups with Mann Whitney U Test after intervention. The p value for SIT & CBT group comparison is more than 0.05 shows that there is no significant difference between these two groups and the p value is less than 0.01 for SIT& BOTH pair and CBT & BOTH pair comparisons shows that there is significant difference with in these two pairs which conforms BOTH group is having statistically significant improvement with the mean \pm SD value of SIT group is 66.10 ± 14.019 , CBT group is 66.70 ± 9.719 and BOTH group is 47.50 ± 5.338 .

DISCUSSION

The purpose of this study was to compare the effectiveness of sensory integration therapy and cognitive behavior therapy in subjects with ADHD. The implication of this study may justify the efficacy of sensory integration therapy and cognitive behavioral therapy in the treatment of ADHD. This comparison demonstrated that treatment of ADHD with proper therapy was efficacious. The groups were synchronized with age between 4 to 6 years. In all groups males were more than the females (70% males and remaining 30% females), this may be due to prevalence of the disease [9], which affects

males more than females. The outcome measure used was Conner's teacher rating scale. The pre treatment scores of Conner's teacher rating scale ($p=0.727$). Beneficial effects found in all three groups.

ADHD is the most frequently diagnosed behavior disorder³⁶ and the most abundantly researched in child psychiatry [37-38]. This disorder consists of a combination of behavioral features, including developmentally inappropriate levels of inattentiveness to task, distractibility, impulsiveness, and motor over activity [39-40]. ADHD is strongly associated with poor academic performance; a pattern of conflictual and often unsatisfactory relations with peers, family members, and teachers; and low self-esteem. To answer the question of optimal types, and frequency of therapy, head to head comparisons in which participants are randomly assigned to receive different therapies are highly needed. There was numerous theories proposed effectiveness of various interventions in treatment of ADHS [30, 31]. Many treatment modes have been developed in the form of behavior modification, life-style changes, counseling, medication, family therapy, school-based interventions, social skills training, parent management training and sensory integration therapy [30,31,35]. Some studies proved effectiveness of sensory integration therapy (SIT) as well as cognitive behavioral therapy (CBT). Results of their study showed significant improvement in the symptoms of ADHD [40-42]. Various evidences are supporting to the sensory integration therapy and also to the cognitive behavioral therapy. In this study one group was treated with sensory integration therapy (group A), second group was treated by cognitive behavioral therapy (group B) and third group treated with combination of both the therapies (group C). Total six months of treatment was given in all the groups.

The result of this study led to inference that sensory integration therapy and cognitive behavioral therapy are equally effective in symptoms in subjects with ADHD, when given with proper dosage. Results indicated treatment given in the group C was the most effective in improving child's symptoms. Numerous studies have come up with effectiveness of sensory

integration therapy and cognitive behavioral therapy in treatment of ADHD [31-33,35]. It would be useful to determine the effectiveness of such interventions in adolescence and adult subjects with ADHD in future studies. The result of this study may be applied to a population with other sensory modulated disorders.

Analysis was done with the base line data and pre and post treatment scores. There was significant improvement ($p < 0.001$) in all the groups after six months of treatment session with sensory integration therapy, cognitive behavioral therapy and both. Before intervention chi-square value was 0.638 with p value more than 0.01 showing that all three groups are homogenous before intervention. After intervention the chi square value was 14.415 and p value equal to 0.001 showing that there was statistically significant difference. The p value for sensory integration therapy group & cognitive behavioral therapy group comparison was more than 0.05 showed that there was no significant difference between these two groups. The p value was less than 0.01 for group A & group C pair and group B & group C pair comparisons showed that there was significant difference with in these two pairs which conforms group C had statistically significant improvement in children with ADHD.

The results of this study may be applied to a population with diagnosis of ADHD. The predominance of male in this study reflects the characteristics of the population that is likely to experience ADHD. This study did not include long term follow up period, though therapies are effective for long term benefits of the interventions [33]. In this study, sensory integration therapy, cognition behavioral therapy and both were given. But the combined therapy of sensory integration therapy and cognitive behavioral therapy found more effective than individual therapy. This would result in better improvement of symptoms from ADHD. Further studies could focus on the long-term benefits of this treatment for this condition and the relative effectiveness of these treatment regimens compared with other approaches.

CONCLUSION

This study concludes that sensory integration therapy is as effective as cognitive behavioral therapy in reducing the symptoms of ADHD. But combination of both the therapy gives better improvement compare to individual therapy in ADHD.

Conflicts of interest: None

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