# AN EXPLORATORY STUDY OF MEDICATED TAKRADHARA IN THE MANAGEMENT OF ATTENTION DEFICIT HYPERACTIVITY DISORDER

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BY

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### Undertaking

I Dr. Ragamala. K. C. is the Ph. D Scholar of the Tilak Maharashtra Vidyapeeth in Kaumarabhritya subject. Thesis entitled An Exploratory Study of Medicated Takradhara in the Management of Attention Deficit Hyperactivity Disorder (ADHD) under the supervision of Dr. Pravat Kumar Dash , Solemnly affirm that the thesis submitted by me is my own work. I have not copied it from any source. I have gone through extensive review of literature of the related published / unpublished research works and the use of such references made has been acknowledged in my thesis. The title and the content of research are original. I understand that, in case of any complaint especially plagiarism, regarding my Ph.D. research from any party, I have to go through the enquiry procedure as decided by the Vidyapeeth at any point of time. I understand that, if my Ph.D. thesis (or part of it) is found duplicate at any point of time, my research degree will be withdrawn and in such circumstances, I will be solely responsible and liable for any consequences arises thereby. I will not hold the TMV, Pune responsible and liable in any case.

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It is certified that work entitled An Exploratory Study of Medicated Takradhara in the Management of Attention Deficit Hyperactivity Disorder (ADHD) is an original research work done by Dr. Ragamala. K. C. Under my supervision for the degree of Doctor of Philosophy in Ayurveda (Kaumarabhritya) to be awarded by Tilak Maharashtra Vidyapeeth, Pune. To best of my knowledge this thesis

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# CONTENTS

# ABBREVIATIONS

| | | |
|---|---|---|
| A.H. | - | Ashtang Hridaya |
| A.S. | - | Astang Sangraha |
| B.P. | - | Bhavaprakash |
| Ca. | - | Charaka Samhita |
| Su. | - | Sutra Sthana |
| Vi. | - | Vimanasthana |
| Sh. | - | Sharirasthana |
| Chi. | - | Chikitsa Sthana |
| Su. | - | Sushruta Samhita |
| Ut. | - | Uttartantra |
| Khi | - | Khila Sthana |
| M.K | - | Madhyama Khanada |
| H.S | - | Harita Samhita |
| K.S | - | Kashayapa Samhita |
| M.N | - | Madhava Nidana |
| B.R | - | Bhaishajya Ratnavali |
| R.R.S | - | Rasa Ratna Samuchaya |
| R.Ni | - | Raj Nighantu |
| K.Ni | - | Kaideva Nighantu |
| Ma.Ni | - | Madanpala Nighantu |
| Yo.R | - | Yoga Ratnakara |
| B.P | - | Bhava Prakasha |
| Sha. | - | Sharangdhara |

**Other**

| | | |
|---|---|---|
| ADHD | - | Attention Deficit Hyperactivity Disorder |
| D S M | - | Diagnostic and Statistical manual for mental disorders |

| | | |
|---|---|---|
| I C D | - | International statistical Classification of Diseases |
| B.T. | - | Before Treatment |
| A.T. | - | After Treatment |
| t | - | Test of significance |
| p | - | Probability |
| S.D. | - | Standard Deviation |
| S.E. | - | Standard Error |
| + | - | Present |
| - | - | Absent |
| % | - | Percentage |
| < | - | Smaller than |
| > | - | Greater than |

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# INTRODUCTION

Children are very much unlike and as different as adults in many aspects. Childhood is a foundation of the adulthood and every incidence occurring in child's life influence in their future life. The importance of child is very well said in the system of *Ayurveda* especially in the *Kaumarabrithya.* This branch deals with the various disorders related to child and also many treatment modalities.

As the days are progressing, the diseases are also growing in the high range. Along with the physical disorders, mental illness is also increasing in children. Psychiatric disorders in childhood have become very common in pediatric population. These disorders are very damaging as they affect the overall development of the child and also affect the quality of life as an adult.

As per WHO, psychiatric disorders among children are to increase by 50% by 2020, on the international level and becomes one of the main causes of morbidity in children. In India children constitute about 40% of our population and the survey studies reported the rate of psychopathology among children is 5-15%. As per surveys in various countries, the commonly found psychological disorders per 1000 children are having following percentage.

- Mental retardation - 25-30%.
- Attention- Deficit/ Hyperactivity Disorder 75-100%.
- Learning disability – 75%.
- Communication disorders including hearing loss 02 – 03%
- Childhood autism 0.2 - 0.5%

These statistics show that ADHD has the highest incidence and commonly seen psychiatric disease among all the other disorders affecting in children all over the world. The prevalence of ADHD in Indian children is found to be approximately 3 to 4 %. The common symptoms of Attention- Deficit Hyperactivity Disorder as per DSM-IV criteria are Inattention, hyperactivity and impulsivity[1] and usually affect the school going children aged 4-12yrs. The incidence in the boys is more than girls in 6:1 ratio and can be diagnosed as early by the age of 4 years[2].

As the Attention deficit hyperactivity disorder has become most common child mental health and developmental disorder, it was selected for the present study. Being such a prevalent disease, the ADHD is having only limited treatment that too with great side effects. If it is not managed properly may lead to many problems in children and also to the parents. This disorder even progresses into adolescence and young adulthood. In modern science, the basic drugs which are used in ADHD are Psycho stimulants, Tricyclic antidepressants, and Tranquilizers. These psycho drugs used to treat ADHD are associated with an increased risk of adverse gastro-intestinal problems, strokes in young adults, mild sleep disturbances, irritability, nervousness, fatigue, dizziness, dry mouth, cardiovascular events, etc. Here comes the role of basic theories developed in our ancient *Ayurvedic* principles and the actual need of our indigenous medicine and several herbal preparations and procedural based therapies, for example *Sirodhara-Takradhara* etc.

ADHD children commonly suffer with academic underachievement, problems with interpersonal relationships with family members and peers, and low self-esteem. They are poor in controlling their impulses and regulating their activity, attention. In *Ayurveda* only little literature is available about child psychology and no such disorder is been explained which is similar to ADHD but only few characters of ADHD can be compared with the some abnormal *Manasika bhavas* and *Manasika rogas* like *Unnmada* as described by *Acharya Charaka* which occur due to defects in the volitional power of the *Manas* i.e. the *Buddhi* or its constituents, the *Dhee, Dhriti* and *Smriti*. Along with *Manasika doshas (Rajas and Tamas), Shareerika doshas (Vata, Pitta, Kapha)* play a role in causing psychosomatic disorders, especially *Vata dosha* deranges the functions of *Manas* leading to *Dhee, Dhriti* and *Smritivibhramsha*[3] and hence treatment modalities can be adopted same as explained in ayurvedic classics for *Manasa vikaras* like - *Medhya* drugs which help to increase *Medhya,* and few procedures like *Murdha taila* which gives calming effect and deep relaxation which helps in the normalization and stabilization of *Manasikabhavas* which is necessary in ADHD child.

A pilot study was conducted at S.V. Ayurvedic hospital, Tirupati prior to the present study to know the effect of Takradhara in ADHD children and showed good positive results. Hence the present study was planned.

In the present study *Takradhara* was used, as it is cost effective and potent panchakarma procedure. It is also being used successfully in the treatment of various psychiatric disorders. It was prepared with few medhya drugs. *Takradhara* causes the pacification of vitiated *Vata*, it is *Indriya Prasadana*, produces relaxing effect, enhance the alertness and concentration abilities, improves cerebral function and cognitive functions and also has anxiolytic action. Hence *Takradhara* was chosen to be beneficial in the management of ADHD.

**Aims and Objectives**

- To evaluate the effect of *Takradhara* in ADHD children aged 7 – 12years.
- To study the properties of the drugs used in T*akradhara*
- To explore about the Attention- Deficit Hyperactivity Disorder from Modern and *Ayurvedic* point of view.

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# MODERN REVIEW

## INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is the most common neurobehavioral disorder of childhood, one of the most prevalent chronic health conditions affecting school-aged children, and the most extensively studied mental disorder of childhood[1].

Attention deficit hyperactivity disorder (ADHD) is a symptom complex characterized by poor ability to attend to a task, motor over activity and impulsivity. These children are fidgety, have a difficult time remaining in their seats in school, are easily distracted, have difficulty awaiting their turn, impulsively blurt out answers to questions, have difficulty following the instructions and sustaining attention, shift rapidly from one uncompleted activity to another talk excessively, intrude on others, often seem not to listen to what is being said, lose items frequently and often engage in physically dangerous activities.

Moderate to severe level of disorder are accompanied by poor school and social performance resulting in easy distractibility. It is important to know that the attention span increases with age. The normal attention span is said to be 3 to 5 minutes per year of age, e.g. a 3-year-old child with have an attention span of 15 minutes[2].

A variety of safe and effective pharmacologic therapies are available to treat the major symptoms of ADHD. Research shows the importance of carefully titrating medications to increase treatment efficacy. There are also effective psychosocial and behavioral treatments that may be beneficial in children with ADHD[3].

## DEFINITION

According to the 4th edition of the American Psychiatric Association's *Diagnostic and Statistical Manual* (DSM-IV), ADHD is characterized by: (1) inattention, including increased distractibility and difficulty sustaining attention; (2) poor impulse control and decreased self-inhibitory capacity; and (3) motor over activity and motor restlessness (Table-1). Definitions may vary in Europe (Table-2).

Affected children commonly experience academic underachievement, problems with interpersonal relationships with family members and peers, and low self-esteem. ADHD frequently co-occurs with other emotional, behavioral, language, and learning disorders (Table -3).

Attention-deficit/hyperactivity disorder (ADHD) is the most common neurobehavioral disorder of childhood and one of among the most prevalent chronic health conditions affecting school-age children. For 40-50% of affected children, the disorder appears to continue with varying manifestations into adulthood, and leads to significant under- and unemployment, social dysfunction, and an increased risk of antisocial behaviors including substance abuse, difficulties maintaining relationships, and encounters with the law[4].

## Frontal Lobe Functioning

### Attention

Most brain processes are heavily dependent on functional arousal, alertness, and attention. Any malfunction within or across these systems will likely cause some degree of breakdown in other cognitive processes. Functional attention subsumes intact neuroanatomic and neurochemical brain systems. Structurally, brain regions involved include subcortical, cortical, and association areas throughout the brain. Primary structures involved include brainstem regions (e.g., basal ganglia), the limbic system (e.g., amygdala and hippocampus), and the frontal lobese (e.g., prefrontal cortex). The neurotransmitter dopamine, along with its neuronal pathways, has been identified as a major chemical modulator of attention. It is through the cognitive mechanisms of attention and executive functions that the child's brain acquires, organizes, and processes information. These mechanisms also allow the child to regulate, plan, and monitor their behaviors and thoughts. Children with attention dysfunction comprise a widely heterogeneous group who show various patterns of impairment of these systems. The resulting symptoms not only affect behavior, learning, and academic skills development, but also have an impact on the child's emotional, social, and adaptive development and functioning. Attention is far from a

unitary, independent, or specific function. This may be illustrated best through the phenotype associated with **Attention-Deficit/Hyperactivity Disorder (ADHD)** [4]**.**

ADHD is not only a disorder of impaired focus, but also includes a host of symptoms related to problems with vigilance, distractibility, impulsivity in thought and behavior, hyperactivity, and flexibility. Disordered attention can occur owing to faulty mechanisms in and/or across subdomains of attention. These subdomains include **selective attention** (the ability to focus attention to a particular stimulus and to discriminate relevant from irrelevant information), **divided attention** (the ability to orient to more than one stimulus at a given time), **sustained attention** (the ability to maintain one's focus), and **alternating attention** (the capacity to shift focus between stimuli).

Attention problems in school-age children can manifest at any point in the process, from arousal through output. Children with diminished alertness and arousal can exhibit signs of mental fatigue in a classroom or when engaged in any activity requiring sustained focus. They might yawn, stretch, fidget, and daydream. They can become overactive in an effort to attain or maintain a higher level of arousal. They are apt to have difficulty allocating and sustaining their concentration, and their efforts may be erratic and unpredictable, with extreme performance inconsistency. These children can also have difficulty discriminating between important and unimportant information. Such weaknesses of determining saliency often result in focusing on the wrong stimuli, at home, in school, and socially, and can result in the child's missing important information and can impede their ability to take notes, to summarize information, or to recognize what to study for a test. In the social context, poor attention may result in inept social interaction (e.g., because of factors such as not "hearing" what others say). Some children present with what has been termed *sluggish cognitive tempo*. Children with sluggish cognitive tempo have many inattentive features without a history of significant hyperactivity and/or impulsiveness. Some researchers believe that sluggish cognitive tempo may be a different disorder from ADHD, with its own characteristics, including hypo activity, lethargy, confusion, and mental "fogginess."

Distractibility can take the form of listening to extraneous noises instead of a teacher, staring out the window, or constantly thinking about the future. These children often show evidence of superficial concentration, where their level of focus is not of sufficient intensity to capture specific information. As a result, these children are often described as "forgetful" because directions and explanations need to be repeated and details (e.g., changes in operational signs in mathematics) may be missed. These children can also exhibit difficulties with cognitive activation and generalization, passively processing and not linking information with prior knowledge and experience, or over relying on prior experience.

Attention dysfunction can affect the output of work, behavior, and/ or social activity. These children have a tendency to perform or act without previewing a likely outcome or thinking through the potential consequences of what they are about to do or say. Their impulsivity can lead to careless mistakes in academic work and unintended misbehavior. It is important to appreciate that most children with attentional dysfunction also harbor other forms of neuro developmental dysfunction that can be associated with academic disorders (with some estimates suggesting up to 60% co morbidity)[4].

## EVOLUTION OF THE CONCEPT OF ADHD

The antecedents of the present conceptualization of ADHD can be traced to the late nineteenth century. A popular German Children's book written in 1863 by Heinrich Hoffmann, entitled Strüwel Peter, colorfully described the characteristics of Attention-Deficit/Hyperactivity disorder. In the early twentieth century, British pediatrician George Still (1902) described a group of 20 children who had problems very similar to those we now diagnose as having ADHD combined type along with conduct disorder which he termed as **"Morbid defects in moral control".** In his opinion, the disorder was the consequence of defects in normal control[5]**.** There was shift in the understanding of such children in 1920s wherein the syndrome began to be viewed as organic in origin. This was attributed to the influenza pandemic following World War I and the epidemic of encephalitis lethargica that occurred during that period. Children who survived frequently developed a severe behavior disorder which was designated as **"Post encephalitic Behavior Disorder"** by Hohman (1922)[6].

Lemke (1932) coined the term **"Inhibited child with choreactic symptoms"** describing hyperactive children. Similar to this Kahn and Cohen (1934) described these childrenas being**"Organically driven"[7].**

Later reports linked a constellation of behavioral manifestations (over activity, restlessness, distractibility, short attention span) to the sequelae of brain insult **"brain damage"[8, 9].** With time the behavioral manifestations were themselves identified as a specific syndrome the **"Hyper Kinetic (hyperactive) child syndrome"[10, 11]**. By the early 1960s the behavioral syndrome and the frequently associated occurrence of learning disability were arbitrarily linked together under the subric of **"Minimal brain dysfunction (MBD)."[12, 13]**. With the time, it became increasingly apparent that the concept of MBD was seriously flawed and served only to compound the already existing confusion. Strategies for the development of unproved classifications schemas emerged in the 1970s and resulted in the elaboration of research diagnostic criteria (RDS) for behavioral disorders[14]. Criteria for ADHD emphasized particular behavioral characteristics inattention, impulsivity and hyperactivity as the principal behavioral manifestations of the syndrome and criteria for the diagnosis of these behaviors were subsequently codified in DSM III [15, 16, 17].

## HISTORICAL REVIEW

The condition now referred as Attention – Deficit / Hyperactivity Disorder (DSMIV) or Hyperkinetic disorder (ICD-10) was first described by George still in 1902. In his lectures to the Royal Academy of Physicians he described a case series of 20 children presenting with problems of over activity, inattention and deficits in volitional inhibition[18]. Subsequent to Dr. Still's lectures a number of different diagnostic labels were assigned to the same symptoms. The condition which we now refer to as ADHD was first included in the second edition of the Diagnostic and Statistical Manual of mental disorders in 1968 and labeled „Hyperkinetic Disorder of childhood. The definition of the condition changed in subsequent editions of DSM, in keeping with changes in Diagnostic nomenclature and delineation of subtypes[19].

It was almost three quarters of a century later that Paul Wender began the work on minimal brain dysfunction that laid the foundation for contemporary work. Wenders work is a landmark that comprised major innovations such as -

1. Describing the syndrome as a developmental disorder.
2. Publishing the first easy to understand patient material.
3. Recognizing that the disorder extending through the life cycle and into adulthood in some patients.
4. Conducting clinical trials of various medications at a time when clinical trials in child psychiatry were in their infancy.
5. Conceptualizing MBD as a neuropsychiatric syndrome in which symptoms would be unlikely to remit with psychotherapy.
6. Recognizing the importance of developing firm age appropriate diagnostic criteria and rating scales.
7. Delineating the phenomenology of the core syndrome and its associated features.

In this regard, Wender's historical position is of considerable interest in his theoretical understanding of the disorder. Wender argued that MBD comprised six dimensions of dysfunction, motor, attention and perception, learning, impulse control, interpersonal relations and emotional disregulation. He suggested that these children were active, extroverted and not easily conditional by normal consequences. Wender went onto develop diagnostic criteria for adult ADHD that included such difficulties as hot temper, emotional reactivity and affective labiality[20]. The result was an accurate description of the breadth of ADHD symptoms. By contrast DSM focuses. On those symptoms, which operationalize the concept of attention, hyperactivity and impulsivity while carefully excluding items that overlap with mood disorders, aggressive items that overlap with conduct disorder, cognitive difficulties that overlap with a thought disorder, or aspects of interpersonal difficulty associated with personality disorder.

The concept of the diagnosis of ADHD has evolved through a complete developmental trajectory dating back to Greek times. The earliest literature referring to the in attentive subtype of ADHD dates back to the writings of the Physician, Alexander Crichton in 1798. In his paper "Mental Restlessness" Dr. Crichton described all the essential features of the inattentive subtype of ADHD which were almost entirely consistent with the criteria for the inattentive subtype as portrayed in DSM.[21]

A number of descriptions of hyperactive children mostly in the form of case reports appeared in the psychiatric literature towards the 2nd half of nineteenth century. The German Physician Henrich Hoffman described the „hyper kinetic syndrome in a case report of a young boy presenting with symptoms of hyperactivity, impulsivity, inattention. In 1870 an Education Act was passed by parliament in Britain that made school attendance compulsory. This had a significant impact on the recognition of symptoms of inattention and hyperactivity as more than just extremes of normal childhood behaviour, and brought the condition increasingly to the attention of the medical profession. This may be one of the reasons why most of the literature pertaining to ADHD dates from 1900.

The Birth of the 20th Century witnessed the birth of the recognition of a disorder which was to become the most diagnosed Child Psychiatric Disorder. Although some attribute the first clear accounts of hyperactivity to Dr. Alexander Crichton (1798), most of the psychiatric literature credits Sir George Still, a paediatrician who presented the Goulstonian Lecturers entitled „Some Abnormal Psychical Conditions in Children to the Royal College of Physician in 1902. He described a case series of 20 children, experience extreme restlessness and an abnormal capacity for sustained attention. Their behaviour was described as violent, destructive, oppositional and non responsive to punishment. He described the condition as "Deficit in Moral Control". The defect of moral control was thought to be the result of a neurobiological affliction due to "some morbid physical condition".

Alfred Tredgald (1908), a member of the English Royal Commission on Mental Deficiency extended stills biological theory and suggested that some forms of brain damage, resulting from birth injury or mild anoxia, though undetected at the

time could present as behaviour problems or learning difficulties in the early school years. He was the first to propose the concept of "Minimal Brain Damage". In addition to symptoms of hyperactivity and educational difficulties, the children he observed exhibited soft neurological signs and motor clumsiness.[21]

A heterogeneous group of children with poor coordination, learning disabilities, and emotional liability, but without specific neurological damage were described as having minimal brain damage. It is originated in the observation that children with brain damage from infection, trauma, hypoxia (including perinatal), and exposure to toxins often exhibited ADHD. It was hypothesized that those with no other signs or symptoms of trauma had minimal brain damage, manifested only behaviorally.

In 1913, Robert Stein, a pediatrician discussed "Children Saturated with Insanity while still in the womb", with "Badly built Minds "and "a kind of Partial Moral Dementia". He observed that children with these afflictions presented with pervasive disruptive behavior problems, evident in the early school years resulting in educational underachievement and relationship difficulties. It is possible that the children he described would today fulfill criteria for ADHD, and his phrase "badly built minds" could equate with current neurobiological findings underlying the disorder. There was shift in the understanding of such children in 1920s wherein the syndrome began to be viewed as organic in origin. This was attributed to the influenza pandemic following World War I and the epidemic of encephalitis lethargica that occurred during that period. Children who survived frequently developed a severe behavior disorder which was designated as "Post encephalitic Behavior Disorder" by Hohman (1922). This period gave rise to theories of "Minimal Brain Dysfunction" (MBD) (Kessler, 1980).[22]

In 1931 the Paediatrician D.W.Winnicott gave a very good description of the "Hyperkinetic Child". He described the child as fidgety, restless, mischievous if left for a moment unoccupied and are over excitable or "nervy" rather than nervous. Lemke (1932) coined the term "Inhibited child with choreactic symptoms" describing hyperactive children. Similar to this Kahn and Cohen (1934) described these children being "Organically driven".[23]

Kanner discussed a syndrome which bears a strong resemblance to the Hyperactive subtype of ADHD in 1935. Despite the significant discovery of the use of psychostimulants in the treatment of ADHD, by Charles Bradly in 1937, drugs were not widely used until the late 1950s, probably because of the psycho analytic climate which prevailed in society during that period which resisted the idea that hyperactive behaviour had a biological basis. These children were classified as having "Hyperkinetic impulsive disorder" in 1950. Hyperactivity was accepted as a brain damage syndrome.

"Hyperactive child syndrome" was described by Stella Chess in 1960.She emphasized activity as the defining feature. The concept of a syndrome of hyperactivity was separated from that of a brain damage syndrome.[24]

Minimal brain dysfunction - The inability to demonstrate brain pathology and the lack of a history of trauma in most such cases led to substitution of "*dysfunction*" for "*damage*" and a corresponding change in terminology to "minimal brain dysfunction". At the end of the decade (1968) the name of the disorder was changed to "Hyperkinetic Disorder of Childhood" DSM II [25]

Douglas (1972) was among the first of great founders who tried to design experiments to test a theory. Her experimental work led her to believe that a disregulation of attention was fundamental to the difficulties of these children[26].

It was partly as a result of her work that the disorder was then renamed attention deficit disorder. She further described difficulty with previously under scribed aspects of cognitive functioning such as problems with efforts and motivation, poor modulation of arousal, and a tendency to seek immediate gratification. She grouped all of these difficulties under one basic concept. ADHD represented an impairment of self regulation. She is one of the pioneers who then pushed interest in ADHD into the arena of neuroscientists exploring the impact of difficulties with executive function.

The name Attention Deficit Disorder was first introduced in 1980 in DSM-III, the third edition of the "Diagnostic and Statistical Manual of Mental Disorders" used in psychiatry. In 1994 the definition was altered to include three groups within

ADHD; the predominantly hyperactive-impulsive type; the predominantly inattentive type; and the combined type[27].

Standardized rating scales have been developed to validate the diagnosis and multimodal treatment approaches are available. Scientific literature continues to blossom and children are being maintained in main stream education. The twenty first century has a lot to offer and we look forward with optimism to further development.

## THEORIES EXPLAINING THE CONCEPT OF ADHD

Barkley (1999c) [28] stated that the fundamental impairment of ADHD is a deficit in delayed responding.

Behavioral disinhibition is seen as fundamental to problems with working memory, self regulation of affect, motivation and arousal internalization of speech (and in turn capacity for rule governed behavior, moral reasoning and reflection) and finally reconstitution. Reconstitution includes problems with verbal fluency, goal directed behavior analysis and synthesis. These ideas represent the first self conscious attempt to enunciate a theory of ADHD that could be tested, and to present that theory to the public at large. Barkley's (1999c) theory is meant to describe the children with ADHD combined type Barkley argues that children with ADHD 1A type who are lethargic rather than hyperactive and withdrawn rather than disinhibited may have a distinct disorder.

Brown (1996, 2001) has developed rating scales for children, adolescents[29], and adults that include various empirically derived dimensions of executive functions.

Brown's model of ADHD differs from Barkley's in that behavioral inhibition is not considered to be primary or super ordinate over other aspects of components of executive functions. His model is meant to be inclusive of all the ADHD subtypes, where Barkley's model specific to the combined type. Barkley suggests that not all problems with attention are ADHD, and that it is incumbent on the clinician to demonstrate the specificity of an attention deficit in the absence of problems with delayed responding by ruling out the presence of any other learning or psychiatric disorder.

## EPIDEMIOLOGY

ADHD affects 3 to 4 percent of children in the USA. Studies of the prevalence of ADHD across the globe have generally reported that 5–10% of school-aged children are affected, although rates vary considerably by country, perhaps in part due to differing sampling and testing techniques.

ADHD persists into adolescence and adult life. Age of onset is usually before 4 years but diagnosis is made around 3 to 4 years of age.[30]

Attention-deficit/hyperactivity disorder (ADHD) is the most common neurodevelopmental disorder of childhood. Studies show a wide range in the prevalence of ADHD. Prevalence of ADHD is estimated as 3% - 5% in school age children Community samples of school aged children suggest a prevalence rate ranging from 4% to 12%.[31] Recent systematic reviews report ADHD prevalence estimates as wide as 2%-18%. [32] Prevalence rates in Indian children range from 5-10%. [33, 34]

Basic information about how the prevalence of ADHD varies by race/ethnicity, sex, age, and socio-economic status remains poorly described. One reason is that difficulties in the diagnosis of ADHD have translated into difficulties developing an adequate case definition for epidemiologic studies.

Diagnosis depends heavily on parent and teacher reports; no laboratory tests reliably predict ADHD. Prevalence estimates of ADHD are sensitive to who is asked what and how information is combined. Moreover the diagnosis of ADHD is complicated by the frequent occurrence of co morbid conditions such as learning disability, conduct disorder and anxiety disorder. Symptoms of these conditions may also mimic ADHD.[35]

Studies that use definitions based on DSM and those take into account some degree of pervasiveness and impairment but allow co morbidity, report prevalence rates in 5-10% range. When the more stringent ICD based criteria are used and the diagnosis is restricted to the presence of the full syndrome without co morbid conditions, 1-2% prevalence rates are found.[36]

Rates may be higher if symptoms (inattention, impulsivity, hyperactivity) are considered in the absence of functional impairment. The prevalence rate in adolescent samples is 2–6%. Approximately 2% of adults have ADHD. ADHD is often under diagnosed in children and adolescents. Youth with ADHD are often undertreated with respect to what is known about the needed and appropriate doses of medications. Many children with ADHD also present with co morbid psychiatric diagnoses, including oppositional-defiant disorder, conduct disorder, learning disabilities, and anxiety disorders (Table -3).

Hence it is suggested that developing an adequate epidemiologic case definition based on current diagnostic criteria is possible and is a prerequisite for further developing the epidemiology of ADHD.

**Male to female ratio of ADHD**

Boys are more affected than girls in a 6:1 ratio.[37]

ADHD is seen to be more prevalent in male sex than in females. Male to female ratio ranges from 3:1 to 4:1 (3.17:1)[38]. Ratio in community sample is approximately 3:1.[39]

The substantial discrepancy in the male-to-female ratio between clinic-referred (10 to 1) and community (3 to 1) samples of children with ADHD suggests that gender differences may be operant in the phenotypic expression of the disease.

Gender differences have been recently highlighted in research primarily because boys are over represented in clinical samples, which may be due to a more noticeable clinical presentation in boys and less impairment seen in girls. Studies have shown that girls with ADHD are predominantly inattentive type and show lesser level of hyperactivity, learning disability and intellectual impairment [40, 41].

It is also postulated that many ADHD children have a deficiency of essential fatty acids (EFAs). Boys are much more commonly affected than girls because males have much higher requirements for EFAs than females.

## ETIOLOGY

One of the theories about the cause of ADHD is, that it is due to minimal brain damage has been disputed. Also, there is no clear relationship between home environment and this syndrome. Excess sugar or food additives believed to make children hyperactive which are true only in 5 percent of cases. Therefore to summarize, ADHD is not caused by too much TV watching, or food allergies, or for that matter excess sugar in the diet or poor home life or poor schools. Scientists have used PET (positron emission tomography) scanner to observe the brain at work and have concluded that brain areas which control attention use less glucose in children with this syndrome. Medication used to increase glucose intake in these parts of the brain which control attention is proved to beneficial in some children. Therefore, this is probably an acceptable theory for the cause of ADHD[42].

Evidence suggests that there is no single factor that determines the expression of ADHD. The emergence of ADHD is best viewed as a final common pathway for a variety of complex brain developmental processes. Multiple factors have been implicated in the etiology of ADHD. Mothers of children with ADHD are more likely to experience birth complications, such as toxemia, lengthy labor, and complicated delivery. Maternal drug use has also been identified as a risk factor in the development of ADHD. Maternal smoking and alcohol use during pregnancy are commonly linked to attentional difficulties associated with the development of ADHD.

Abnormal brain structures are linked to an increased risk of ADHD, because ⅔ of children with severe traumatic brain injury are reported to have subsequent onset of substantial symptoms of impulsivity and inattention. Structural (functional) abnormalities have been identified in children with ADHD without pre-existing identifiable brain injury. These include dysregulation of the frontal subcortical circuits; small cortical volumes in this region; widespread, small-volume reduction throughout the brain; and abnormalities of the cerebellum.

Psychosocial family stressors may also contribute to or exacerbate the symptoms of ADHD.

The symptoms of ADHD are caused by a neurological dysfunction within the brain. Several studies using PET scans have confirmed that there is a definite difference in brain functioning between a group of individuals diagnosed with ADHD and those without it. The underlying physiological mechanism which causes ADHD is still not thoroughly understood and remains under scientific study. So a number of risk factors have been associated with ADHD, no factor or any combination is sufficiently explanatory to account for all ADHD cases. It may require a combination of genetic factors and environmental factors for the full syndrome to emerge. Thus ADHD is not due to any single or specific cause; rather they represent the consequence of multidimensional "transactions" among intrinsic characteristics of the child and environmental factors.

The etiological factors of ADHD identified by various researches can be considered under the following headings.

**GENETIC**

ADHD is one of the most heritable conditions in all of psychopathology. 70-80% of the individual differences in ADHD-related symptoms are attributed to genetic rather than environmental factors.[43] Recent studies describe ADHD as a polygenic disorder that involves multiple genes that determine the severity of symptoms.[44] The pattern of inheritance suggests an Autosomal dominant gene transmission[45]. The genetic basis of the disease revealed by the following research findings.

ADHD more common in first degree biological relative of children with same disorder[46].

Incidence of ADHD in parents of children newly diagnosed with ADHD is 25% indicating a strong genetic predisposition.[47]

Male monozygotic twins had a significantly higher rate of ADHD versus non twin siblings[48].The concordance rate for ADHD was greater for monozygotic twins than for dizygotic twins[49].

Evidence for association exists for four genes related with neurotransmitters: the dopamine D4 and D5 receptors and the dopamine and serotonin transporters. Molecular genetics investigations suggest Dopamine transporter gene (Chromosome 5p 15.3) and Dopamine D4 - receptor gene (Chromosome 11p 15.5) defect was found in 30% of general population and 60% of AD / HD population.[50, 51]

Further evidence comes from the association with Touretts disorder which is believed to be due to a dominant gene with variable penetrance, half of patients with Touretts disorder also have ADHD.

There appears to be a strong genetic component to ADHD, with heritability estimates purported to be as high as 0.80. Genetic studies have primarily implicated 2 candidate genes, the dopamine transporter gene *(DAT1)* and a particular form of the dopamine 4 receptor gene *(DRD4)*, in the development of ADHD. Additional genes that may contribute to ADHD include *DOCK2* associated with a pericentric inversion 46N inv(3)(p14:q21) involved in cytokine regulation, a sodium-hydrogen exchange gene, and *DRD5, SLC6A3, DBH, SNAP25, SLC6A4,* and *HTR1B.*(nelson)

**Immune system & ADHD**

Scientists have found a variation in an immune system gene directly related to ADHD. Children carrying a genetically based variant of this gene were found to be more susceptible to ADHD. This variation of the gene seems to interfere with the function of Interleukin. Interleukin 1 protects the adult against non immune stress, helps to maintain the health of neurons as they age, aids in the development of neurons in embryonic development and regulate the release of dopamine and nor epinephrine in several brain systems. A defect in interleukin can thus directly affect the brain.[52, 53, 54]

**BIOLOGICAL FACTORS**

**Neurochemical factors:** Neurotransmitters are chemicals liberated by a presynaptic neuron into the synaptic cleft and are used to amplify, modulate and relay signals between a neuron and another cell.[55]

**Dopamine & Norepinephrine**

Dopamine is a neurotransmitter involved in reward, risk taking, impulsivity, and mood. Nor epinephrine modulates attention, arousal and mood. Inattention and distractibility appear to be related to low levels of norepinephrine. The impulse and behavior problems found in ADHD appear related to low levels of Dopamine in the brain.[56]

Some studies suggest that ADHD Children/Adults may have only ten to twenty-five percent of these two neurotransmitters found in the normal brain. In treatment, medications effective with ADHD Children/Adults are those which alter levels of Dopamine and norepinephrine. Stimulate medications (Ritalin) are known to increase the production of these two neurotransmitters - boosting their levels into the normal range and producing increased attention and decreased impulsivity. Other medications with similar actions, such as antidepressant medications, can also be of use in the treatment of ADHD.[57]

Brain studies on individuals with ADHD suggest a defect in the dopamine receptor D4 (DRD4) receptor gene and over expression of dopamine transporter-1 (DAT1). The DRD4 receptor uses DA and NE to modulate attention 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. The Dopamine transporter gene defect has been hypothesized to result in too rapid turnover of dopamine at dopamine synapse. While the D4 gene defect may result in dopamine receptor hyposensitivity.[58]

**Serotonin**

Serotonin is the predominant central inhibiting neurotransmitter. An inability to inhibit may underlie the observed impulsivity in AD/HD. Reports of increased aggression and activity in animals depleted of serotonin resulted in investigation into its role in AD/HD.

Tricyclic Antidepressant Medications (TCAs) and monoamine Oxidase Inhibitors (MAOIs) which are known to increase CNS serotonin levels improve

ADHD symptoms. However, clinical trials with L-tryptophan, the amino acid precursor of serotonin, showed no effectiveness. Fenfluramine, an appetite suppressant that increases and then depletes brain serotonin, was also found not to affect behavioral symptoms.[59] The marked innervations of motor regions of the brain by 5-HT(Serotonin) projections and the clear involvement of 5-HT systems in the control of locomotion in animals suggests a likely node for dysfunction in ADHD. The few relevant studies do not show evidence of this, the role of serotonin in the genesis of AD/HD remains obscure.

**Glutamate & GABA**

Studies show children with ADHD have a two-and-half-fold increased level of glutamate, an excitatory brain chemical that can be toxic to nerve cells and a decreased level of GABA, a neuro-inhibitor. This combination may explain the behavior of children with poor impulse control.[60]

**DISRUPTION IN BRAIN DEVELOPMENT**

A variety of brain insults are associated with an increased risk of ADHD but none has been consistently demonstrated. The insults include antenatal and perinatal hypoxia, premature deliveries and low birth weight ,obstetrical and other head traumas, intra uterine infections like rubella, post natal infections like encephalitis and meningitis, and exposure to toxins either prenatal or post natal period.

**Prematurity** & **Low birth weight**

Prematurity has been highlighted as a major cause predisposing to ADHD. Cherkes and Julkowski (1998) report that among a group of children born on average. 49 days early with birth weight of 4.14 lbs. 75% had by grade 5 at least one learning problem including ADHD 47% of children with Very low Birth Weight may have poor attention span and 23% have AD / HD (Vs. 6% with normal birth weight) (Bottling et al. 1997).[61]

A study of detailed medical records (Danish medical and population registers) shows that being born too soon or underweight increases a baby's chances of later developing hyperkinetic disorder. Compared with children born at term, children with

gestational ages between 34 and 36 completed weeks had an 80 percent increased risk of HKD, and children with gestational ages below 34 had a three-fold increased risk," said the researchers. "Children born at term with birth weights between 1,500 and 2,499 grams had more than a twofold increased risk of HKD compared with children born at term with birth weights above 2,999 grams, whereas children with birth weights between 2,500 and 2,999 grams had a 70 percent increased risk. Exactly how preterm birth and poor intrauterine growth affect the fetal brain to cause HKD is unclear. One possibility is that fetal hypoxia and hypotension injure the striatal complex of the basal ganglia and increase the number of dopamine receptors. Under nutrition during fetal brain development may also have long-term effects on attention, learning, and memory, as animal studies have shown.[62]

**Obstetric complications**

Obstetric complications involving anoxia or prolonged hypoxia are suspected to increase the risk for such mental disorders as schizophrenia and ADHD. Study on animals shows Perinatal Distress leads to Lateralized Medial Prefrontal Cortical Dopamine Hypofunction.[63]

**Head Injuries**

Evidence supports that trauma (in particular mild concussive injury to the head, neck or upper back) increases the risk of learning / behavioral disorder onset. A study conducted on 76 children without prior history of ADHD suggests Closed-head injury–induced lesions in the right putamen in children are associated with subsequent development of secondary ADHD. Out of the 76 children, 15 developed Secondary ADHD.[64]

**Infections**

Certain postnatal infectious diseases such as meningitis or encephalitis can affect the brain tissue and thereby change the process by which the brain sends signals and ultimately may result in the manifestation of the symptoms of ADHD.[65]

**PSYCHO SOCIAL FACTORS:**

Child rearing and socialization practices have also been implicated in causation of ADHD.[66]Children reared in institutions have increased rates of inattention and over activity suggestive of ADHD. These signs result from prolonged emotional deprivation, and they disappear when deprivational factors are removed, such as through adoption or placement in a foster home. Biedermann et al. found a positive association between six previously identified risk factors within the family environment that correlated significantly with childhood mental disturbances and risk for ADHD. Severe marital discord, low social class, large family size, paternal criminality, maternal mental disorder and foster placement.[67] Prospective data show that prenatal stress is associated with disturbed attention regulation (Huizink et al., 2002) and activity in infants.

Anxiety in late pregnancy predicted hyperactivity and inattention symptoms in four year old boys and follow up in eight year old boys and girls (O‟ Connor et al., 2003). Lack of proper sleep and sleep disorders have been correlated with children suffering from ADHD[68, 69, 70, 71].

**ENVIRONMENTAL FACTORS**

ADD has been diagnosed for hundreds of years, but more recently has become more prevalent due to the increased exposure to pollutants, chemicals or heavy metal toxicity (such as lead, mercury, and cadmium).

**Prenatal maternal smoking**

Maternal smoking is a known risk factor for HKD in offspring.[72, 73] Maternal smoking causes fetal hypoxia and also causes disturbances to the dopamine systems in the prefrontal cortex.( Longo, Fung and Lan 1989)

**Prenatal maternal drinking**

A Study analyzing data from 4912 mothers showed Children whose mothers drank alcohol during pregnancy had more conduct, attention and impulsivity problems than unrelated children whose mothers did not drink.[74]

**Heavy metal toxicity** [75]

**Lead:** Various studies have been conducted to evaluate the relationship between lead levels and attention-deficit hyperactive behaviors in the children. Scalp hair should be considered as a useful clinical and epidemiologic approach for the measurement of chronic low-level lead exposure in children. It appears from these and other studies that body lead burden is associated with impaired neurological function in children. Following this line of reasoning, studies have also shown that removal of lead stores through chelation therapy has produced significant improvements in behavior.

**Manganese**: A study on 68 children who have been described as „hyperactive" showed a raised level of manganese in the hair.

**Cadmium:** High cadmium has been detected in some mineral studies of ADHD children. (Ward) Low hair zinc may be a marker for elevations in cadmium. Exposure to radiations, teratogens and lead etc. during ante natal period particularly in first trimester is considered as a risk factor for ADHD.

**DIETARY FACTORS**

As early as 1922 dietary factors have been suspected of exacerbating, if not causing, cognitive and behavior problems among some individuals with developmental disorders (Shannon, 1922, as cited by Atkins, 1986). Although any such association has often been dismissed based on early studies of children with hyperactivity, the hypothesis continues to be discussed and retested.

**Food Additives & Allergies**

Studies show elimination of food additives and refined sugar produces considerable improvements in ADHD. So the most common alternative therapy suggested for ADHD involves changes in diet. Dr**.** Benjamin Feingold, an allergy specialist, reported that dyes, preservatives and salicylates could cause hyperactivity in children. Dr. Feingold made his original presentation to the American Medical Association in 1973 based on his experience with 1200 individuals. Food sensitivities and food allergies provoke hyperactivity. Data from two double blind studies indicated

that 73-76% of ADHD children responded favorably to food elimination diets. Maintenance on low antigen diets raised the success rate to 82%. [76], [77], [78], [79], [80], [81]

Food sensitivities and food allergies through partially digested food (exorphins) entering the blood stream and scrambling the neuronal communication systems. In eight out of nine studies 86% of hyperactive children had elevated eosinophils indicative of allergy or parasitic infection. The effect of food on behavior of a subtype of children with ADHD was supported by topographic mapping of brain electrical activity in children considered to have food induced ADHD (Uhliq, Merkenschlager, Brandmaiser & Egger, 1997). These researchers examined EEG recordings of children while they were on a restricted diet as well as when they were fed offending foods. They found an increase in beta activity in the fronto temporal areas of the following consumption of provoking food.

**Sugar and ADHD**

Most researchers say that sugar doesn't make children hyperactive. Yet, everyone particularly the mothers of ADHD children have seen their children go crazy on sugar! There is no concrete evidence that sugar causes ADHD. However, the evidence against this notion is also not very strong. We know that ADHD children frequently have abnormal sugar metabolism and it is known that eating sugar does affect learning and behavior negatively, particularly after a low protein carbohydrate meal. This occurs even in normal children. The metabolism of sugar drains the body's reserve of other vital nutrients. Basically, it is very likely that the medical researchers are correct in saying that sugar ingestion does not cause ADHD; means if a normal child is given too much sugar, he will not develop ADHD. However, it is clear that refined sugar does exacerbate some of the ADHD symptoms such as inattentiveness and possibly aggression in many children.[82]

**Poor Nutrition**

Assessment of ADHD children often reveals nutrient deficiencies or imbalance which, when corrected resulted in considerable behavioral and academic improvement. All important neurotransmitters are manufactured by the body from dietary sources. In order for these neurotransmitters to function well, the B vitamin,

Magnesium, Zinc and Vitamin C must all be present in sufficient amounts. Infant malnutrition is a strong risk factor for ADHD. Even a child who gets sufficient nutrition later in life may develop ADHD as a result of malnutrition in infancy.[83] Good nutrition during pregnancy and in early years of the child's life may help in preventing ADHD.

**Maternal Iodine Deficiency**

There is an increased risk of attention deficit / hyperactivity disorder in children born to mothers with an Iodine deficiency. Francesco Veronighu and Colleagues reported 87.5% prevalence of ADHD in a group of children born to women who suffered from Iodine deficiency during pregnancy. Researchers suggested that this may be due to an inadequate supply of maternal thyroid hormone to the fetal brain[84].

**Zinc**

Several studies conducted in different countries have found zinc to be low in ADHD sufferers[85].Many studies have shown that Zinc supplementation is helpful with memory, thinking and IQ. Children with ADHD who are unresponsive to stimulant drugs are more likely to be zinc deficient than children who respond favorable to these medications[86].Zinc is an important factor in metabolism, relevant to neurotransmitters, fatty acids and prostaglandins and indirectly affects dopamine metabolism[87]. In addition zinc is an important component of the enzyme, delta 6 desaturase, which converts Omega 3 fatty acids to DHA[88].

**Magnesium**

A study on ADHD found that 95% of ADHD children tested were deficient in magnesium. Low magnesium may be associated with hyperactivity due to hyperirritability of brain neurons. Studies have shown that supplementation with magnesium can improve behavior and cognitive performance in children with ADHD. Magnesium is also a calming mineral that relaxes nerves and muscles and diminishes the effects of stress.[89, 90].

**Iron**

Researchers have discovered that children with ADHD have abnormally low levels of iron in their blood. Low iron levels are linked with learning disabilities and impaired cognition. A study on ADHD children showed treatment with iron supplementation caused significant decrease on the Conner's Parent Teacher rating scale. Iron stores are vital for brain function, as it is thought to be central to the way brain uses dopamine, the neurotransmitter that governs mood and attention[91].

**Vitamin B6 (Pyridoxine)**

Pyridoxine can help ameliorate hyperactivity. Coleman reported that B vitamins improved the behavior of some children with ADHD in a double blind cross over comparison with metlhylphenidate[92]. VitaminB6 is an essential cofactor for a majority of the metabolic pathways of amino acids including decarboxylation pathways for dopamine, adrenaline and serotonin. It was also observed that high dose Vit. B6 reduced the symptoms while boosting serotonin levels into normal range.[93]

**Essential fatty acids (EFAs)**

Many ADHD children have a deficiency of essential fatty acids (EFAs) either because they cannot metabolise linoleic acid normally, or because they cannot absorb EFAs normally from the gut, or because their EFA requirements are higher than normal. The main pieces of evidence are:

Most of the food constituents which cause trouble in ADHD children are weak inhibitors of the conversion of EFAs to prostaglandins (PGs).

Boys are much more commonly affected than girls and males are known to have much higher requirements for EFAs than females.

A high proportion of ADHD children have abnormal thirst and thirst is one of the cardinal signs of EFA deficiency.

Many of ADHD children have eczema, allergies and asthma which some reports suggest can be alleviated by EFAs.

Many of ADHD children are deficient in zinc which is required for conversion of EFAs to PGs.

Some ADHD children are badly affected by wheat and milk which are known to give rise to exorphins in the gut which can block conversion of EFAs to PGE1.

A 1994 study at Purdure University found that boys diagnosed with ADHD had lower levels of the Omega 3 essential fatty acid DHD (American Journal of Clinical Nutrition). The cell membranes and synaptic endings of neurons in our brain and nervous system are composed of DHA, an Omega 3 essential fatty acid. These membranes go rancid unless protected with antioxidants. Since most people don't get enough DHA, other types of fats are in corporated in to the brain, but they do not function as well. A preliminary study of EFA supplementation in a number of ADHD children had given promising results.

**Phosphatidyl serine**

In a study of ADHD children aged between 4 and 19 years, dietary supplementation with phosphatidyl serine benefited greater than 90% of the cases. An intake of 100-300 mg/day of phosphatidyl serine, attention and learning were most consistently improved.[94] Phosphatidyl serine is clinically proven to benefit a wide range of brain functions. It is a key consistent of nerve cell synaptic membranes, which are deeply involved in the production of neurotransmitters. Ingested as a supplement, phosphatidyl serine energise the human brain, facilitating synaptic connectivity and specifically boosting dopamine transmitter functions i.e. its production, release and post synaptic receptor actions.[95]

**Amino acids**

A study on plasma amino acid examination in a group of 28 patients with attention deficit disorder (ADD) and 20 control subjects showed significantly lower levels of phenylalanine, tyrosine, tryptophan, histidine, and isoleucine. These data suggest a general deficit in amino acid transport or absorption. Serum amino acid levels as well as other nutrient cofactors may influence synthesis pathways for certain inhibitory and excitatory neurotransmitters.

**Thyroid Abnormalities**

Contradictory findings have been reported on associations between ADHD and thyroid abnormalities including the syndrome of generalized resistance to thyroid hormone. Systematic review of thyroid function in a large group of children and adolescents with ADHD (N=132) showed evidence of generalized resistance to thyroid hormone.[96]

**Brain Abnormalities** Subtle structural abnormalities in the brain circuit that inhibits thoughts have been confirmed in the first comprehensive brain imaging study of ADHD. The researchers have found that the entire right cerebral hemispheres in boys with ADHD were, on average, 5.2% smaller than those of controls. Three structures in the affected circuit on the right side of the brain -- prefrontal cortex, caudate nucleus and globus pallidus -- were smaller than normal in the boys with ADHD, when examined as a group. The prefrontal cortex, located in the frontal lobe just behind the forehead, is believed to serve as the brain's command center. The caudate nucleus and globus pallidus, located near the middle of the brain, translate the commands into action.[97] Studies using PET scans have found decreased cerebral blood flow and metabolic rates in the frontal lobe areas of children with ADHD compared with controls.

## PATHOGENESIS

In children with ADHD, MRI studies indicate a loss of normal asymmetry in the brain, in addition to smaller brain volumes of specific structures, such as the prefrontal cortex and basal ganglia. Children with ADHD have approximately a 5–10% reduction in these brain structures. Functional MRI findings suggest low blood flow to the striatum. The prefrontal cortex and basal ganglia are rich in dopamine receptors. This knowledge, plus data about the dopaminergic mechanisms of action of medication treatment for ADHD, has led to the **dopamine hypothesis,** which postulates that disturbances in the dopamine system may be related to the onset of ADHD.

Fluorodopa positron emission tomography scans have also supported the dopamine hypothesis through the identification of low levels of dopamine activity in adults.[98]

The underlying physiological mechanism which causes ADHD is still not yet thoroughly understood. Study shows Brain volume was slightly smaller in ADHD patients. A study on 152 children with ADHD and 139 controls using MRI scan showed 3.2% and 3.5% reduction in the cerebral and cerebellar brain volume in children with ADHD. Defect in response inhibition is one of the major features of ADHD. Frontal lobe particularly of the right hemisphere plays critical role in inhibition of the response. Studies have provided evidence for frontal striatal dysfunction in ADHD and hypothesized to be primary defect in the Disorder[99].

Functional imaging studies in children with ADHD using Xenon 133 inhalation and Positron Emission Tomography (PET), showed frontal lobes and the caudate nuclei were less well perfused and showed reduced metabolic activity[100]. Studies have also shown reduction in activation of some other areas like caudate nucleus particularly left, right inferior parietal lobe, right superior temporal gyrus, bilateral cingulate gyri, precuneus and basal ganglia.

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 receptor D4 (DRD4) gene and over expression of dopamine transporter-1 (DAT1) gene. 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. The implications of these limited receptor findings require further study; however, it seems clear that dopamine and norepinephrine are involved in the pathophysiology of ADHD.[101]

The noradrenergic system has been intimately associated with the modulation of higher cortical functions including attention, alertness, vigilance and executive

function. Brain imaging studies fit well with the idea that dysfunction in fronto-subcortical pathways occurs in ADHD with its underlying dysregulation of noradrenergic function.[102]

Dopaminergic neurotransmission / dysfunction are strongly implicated in pathophysiology. Dopamine receptor gene, DRD4, DRD5, dopamine transporter gene DD, and the Dopamine beta hydroxylase DBH gene have all been confirmed to be strongly associated with ADHD by research group world wide.[103]

A programmatic research of sergeant Van der Meere and colleagues in Holland for the evidence for a motor control deficit in ADHD employing an information processing paradigm have isolated the cognitive deficit in those with ADHD to the motor control stage rather than to an attentional or information processing stage. More specifically, their research suggests that the deficit is not at the response choice stage but at the motor presetting stage involved in motor preparedness to act. There appears to be both a greater sluggishness and greater variability in motor preparation. Fuster identified this type of motor preparedness, or anticipatory set as one of the major effects that the executive functions would have on motor control. But he also identified sensitivity to errors or response feed back as a second influence of the executive functions on the motor control system. Deficits in behavioral inhibition should lead to insensitivity to errors and to a loss of behavioral flexibility as a consequence, and research has identified such insensitivity in children with ADHD.

## CLINICAL MANIFESTATIONS

Clinical manifestations of ADHD may change with age. The symptoms may vary from motor restlessness and aggressive and disruptive behavior, which are common in preschool children, to disorganized, distractible, and inattentive symptoms, which are more typical in older adolescents and adults. ADHD is often difficult to diagnose in preschoolers because distractibility and inattention are often considered developmental norms during this period.[104]

(1) Attention difficulties

Children with ADHD inattentive type are mainly impaired in school. Although they may have some difficulty with social and family relationships the presenting problem typically is academic underachievement.

Teachers complain about these children being chronically late, forgetful,disorganized, losing, things, day dreaming, off task, unable to finish their work and procastinating.

Attention problems may include being "Scatterbrained" "Spaced out", or notlistening". They may also include problems with motivation, variability in performance, and difficulties with understanding sequenced commands or following instructions.

Parents may come to the clinic stating that then child "pays excellent attention,they play video games for hours". For the clinician, a child who is stuck on attention relieving activities such as playing video games, using construction sets,or watching television may be the very child who has an attention deficit.

**SYMPTOMS COMMONLY ENCOUNTERED IN ASSOCIATION WITH ATTENTION**

Symptoms Range of Manifestations

1. Poor concentrations
    - Auditory and / or visual distractibility.
    - Free flight of ideas
    - Dissociation of attention and activity.
    - Foreground, background confusion.
    - Inattention to detail.
2. Activity de-control
    - Inappropriate levels of activity.
    - Purposeless motor output (e.g.fidgetiness)
    - Impersistence at tasks

3. Cognitive fatigue

- Difficulty falling a sleep at night.
- Evidence of excessive fatigability during day
- Easy tiring during cognitive tasks.
- Diminished working capacity

4. Disinhibition

- Impulsive behavior
- Tactlessness
- Antisocial acts

5. Altered cognitive tempo

- Problems with planning and organization.
- Poor self monitoring, carelessness

6. Instability

- Constant yearning for intense experience.
- Poor reinforceability.
- Egocentricity
- Difficulty delaying gratification.

**(2) Hyperactivity:**

The restlessness of the hyperactive child is more than excessive activity,although the latter was demonstrated to be present during structured inseat, activity (Backley et al. 1999) as well as in sleep (Porrino, et al. 1983, a, b)[105,106,107]

Hyperactivity is off task, out of seat and disruptive. The activity is developmentally inappropriate and is not goal directed or purposeful to the task on hand. Klein and Young (1979) hold the view that it is the combination of high activity with high disruptive behavior that distinguishes the ADHD child from the normal child[108]. The difference lies in quality as well as quantity of activity.

Hyperactivity is clearly situation dependent varying with the type of activity, interest in the activity, amount of adult attention available, and the relationship of adult and child Whalen and Henker (1991) concluded that the level of hyperactivity

was a product of a given child, the situation and the observer. Furthermore, hyperactivity varies unpredictably in any one child from day to day.[109]

**(3) Impulsivity**

Impulsivity refers to the inability to delay a response despite the anticipation of negative consequences for the behavior.

The difficulty in controlling impulses as rated in comparison to mothers of the same age and gender. The manifestation of this difficulty varies across the life span.

Impulsivity shows itself in behavioral and academic difficulties in elementary school. In the classroom these include interrupting or blurting out answers without waiting to have the questions and difficulties waiting in line. Impulsive ADHD children are more daring than their peers. Therefore accidents continue to be more common. Peer relationships are marred by being a poor loser, wanting "his way or no way" having to be the boss or leaving the game, and getting into physical fights if feelings are hurt. Assignments are not completed or handed in, homework may become a daily battle and affect family functioning.

School work is replete with errors, detail is missing, wrong is mercy and the answers are written without reading the question carefully.

Impulsivity across the life span has been considered to be among the most serious aspects of ADHD in causing functional impairment and also among the most difficult to treat. [110]

**DIAGNOSIS AND CLASSIFICATION**

There are two sets of diagnostic criteria in regular use currently to diagnose psychiatric and behavioral disorders in children: DSM-IV and ICD-10. ADHD is a DSM-1V diagnosis, that is, it is a diagnosis found in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders published by the American Psychiatric Association (1994). ADHD does not appear in ICD-10 - the classificatory system published by the World Health Organization (WHO, 1992) and the preferred

system used in the UK and Europe. In ICD-10 the nearest equivalent diagnosis to ADHD is that of hyperkinetic disorder (HKD).

**TABLE -1 -- DSM-IV Diagnostic Criteria for Attention-Deficit/Hyperactivity Disorder**

**A. Either 1 or 2**

**1.** Six (or more) of the following symptoms of inattention have persisted for ≥6 mo to a degree that is maladaptive and inconsistent with development level:

*Inattention*

**a.** Often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities

**b.** Often has difficulty sustaining attention in tasks or play activities

**c.** Often does not seem to listen when spoken to directly

**d.** Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to opp ositional behavior or failure to understand instructions)

**e.** Often has difficulty organizing tasks and activities

**f.** Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)

**g.** Often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, tools)

**h.** Is often easily distracted by extraneous stimuli

**i.** Is often forgetful in daily activities

**2.** Six (or more) of the following symptoms of hyperactivity-impulsivity have persisted for ≥6 mo to a degree that is

maladaptive and inconsistent with developmental level:

*Hyperactivity*

**a.** Often fidgets with hands or feet or squirms in seat

**b.** Often leaves seat in classroom or in other situations in which remaining seated is expected

**c.** Often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)

**d.** Often has difficulty playing or engaging in leisure activities quietly

**e.** Is often "on the go"or often acts as if "driven by a motor"

**f.** Often talks excessively

*Impulsivity*

**g.** Often blurts out answers before questions have been completed

**h.** Often has difficulty awaiting turn

**i.** Often interrupts or intrudes on others (e.g., butts into conversations or games)

**B.** Some hyperactive-impulsive or inattentive symptoms that caused impairment were present before 7 yr of age

**C.** Some impairment from the symptoms is present in 2 or more settings (e.g., at school [or work] or at home)

**D.** There must be clear evidence of clinically significant impairment in social, academic, or occupational functioning

**E.** Symptoms do not occur exclusively during the course of a pervasive developmental disorder, schizophrenia, or other psychotic disorder, and are not better accounted for by another mental disorder (e.g., mood disorder, anxiety disorder, dissociative disorder, personality disorder)

| **CODE BASED ON TYPE** |
|---|
| 314.01 Attention-deficit/hyperactivity disorder, combined type:if both criteria A1 and A2 are met for the past 6 mo |
| 314.00 Attention-deficit/hyperactivity disorder, predominantly inattentive type:if criterion A1 is met but criterion A2 is not me t for the past 6 mo |
| 314.01 Attention-deficit/hyperactivity disorder, predominantly hyperactive-impulsive type:if criterion A2 is met but criterion A1 is not met for the past 6 mo |

Development of the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (DSM-IV) criteria leading to the diagnosis of ADHD occurred mainly in field trials with children 5-12 yr of age. Fewer studies utilizing *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5) criteria are available, but those that are available suggest a good correlation with data from DSM-IV criteria-based studies, despite the broadened age-based definition for onset of symptoms in DSM-5.

The DSM-IV criteria state that the behavior must be developmentally inappropriate (substantially different from that of other children of the same age and developmental level), must begin before age 7 yr, but the current DSM-5 criteria state that the behavior must be developmentally inappropriate (substantially different from that of other children of the same age and developmental level), must begin before age 12 yr, must be present for at least 6 mo, must be present in 2 or more settings and reported as such by independent observers, and must not be secondary to another disorder.

A diagnosis of ADHD is made primarily in clinical settings after a thorough evaluation, including a careful history and clinical interview to rule in or to identify other causes or contributing factors; completion of behavior rating scales by different observers from at least 2 settings (e.g., teacher and parent); a physical examination; and any necessary or indicated laboratory tests which arise from conditions suspected based on history and/or physical examination. It is important to systematically gather and evaluate information from a variety of sources, including the child, parents,

teachers, physicians, and, when appropriate, other caretakers, over the course of both diagnosis and subsequent management.[111]

Children with a disorder usually have intelligent quotient at par with age but have difficulties in scholastic performances. Some studies have suggested that hyperactive children have higher verbal scores than performance scores on the Wechsler Intelligence Scale and lower scores on the Attention concentration subtest. Psychometric tests should cover four essential areas—language skills, visuospatial skills, sequential analytic skills and motor planning and execution skills. Educational level, as measured on the Peabody Individual Achievement test and the wide range achievement test, may be lower than expected for age IQ, especially for children who also have learning disabilities. Specific test for learning disabilities should be administered to pin point areas of difficulty.[112]

DSM-5 identifies 3 subtypes of ADHD. The first subtype, *ADHD, predominantly inattentive type,* often includes cognitive impairment and is more common in females. The other 2 subtypes, *ADHD, predominantly hyperactive-impulsive type,* and *ADHD, combined type,* are more commonly diagnosed in males.[113]

**DIAGNOSTIC CRITERIA**

**DSM-5**

1. A persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development, as characterized by (1) and/or (2):

**1. Inattention:** Six (or more) of the following symptoms have persisted for at least 6 months to a degree that is inconsistent with developmental level and that negatively impacts directly on social and academic/occupational activities:

• Note: The symptoms are not solely a manifestation of oppositional behavior, defiance, hostility, or failure to understand tasks or instructions. For older adolescents and adults (age 17 and older), at least five symptoms are required.

1. Often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or during other activities (e.g., overlooks or misses details, work is inaccurate).

2. Often has difficulty sustaining attention in tasks or play activities (e.g., has difficulty remaining focused during lectures, conversations, or lengthy reading).

3. Often does not seem to listen when spoken to directly (e.g., mind seems elsewhere, even in the absence of any obvious distraction).

4. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g., starts tasks but quickly loses focus and is easily sidetracked).

5. Often has difficulty organizing tasks and activities (e.g., difficulty managing sequential tasks; difficulty keeping materials and belongings in order; messy, disorganized work; has poor time management; fails to meet deadlines).

6. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (e.g., schoolwork or homework; for older adolescents and adults, preparing reports, completing forms, reviewing lengthy papers).

7. Often loses things necessary for tasks or activities (e.g., school materials, pencils, books, tools, wallets, keys, paperwork, eyeglasses, mobile telephones).

8. Is often easily distracted by extraneous stimuli (for older adolescents and adults, may include unrelated thoughts).

9. Is often forgetful in daily activities (e.g., doing chores, running errands; for older adolescents and adults, returning calls, paying bills, keeping appointments).

**2. Hyperactivity and impulsivity:** Six (or more) of the following symptoms have persisted for at least 6 months to a degree that is inconsistent with developmental level and that negatively impacts directly on social and academic/occupational activities:

• Note: The symptoms are not solely a manifestation of oppositional behavior, defiance, hostility, or a failure to understand tasks or instructions. For older adolescents and adults (age 17 and older), at least five symptoms are required.

1. Often fidgets with or taps hands or feet or squirms in seat.

2. Often leaves seat in situations when remaining seated is expected (e.g., leaves his or her place in the classroom, in the office or other workplace, or in other situations that require remaining in place).

3. Often runs about or climbs in situations where it is inappropriate. (Note: In adolescents or adults, may be limited to feeling restless.)

4. Often unable to play or engage in leisure activities quietly.

5. Is often "on the go," acting as if "driven by a motor" (e.g., is unable to be or uncomfortable being still for extended time, as in restaurants, meetings; may be experienced by others as being restless or difficult to keep up with).

6. Often talks excessively.

7. Often blurts out an answer before a question has been completed (e.g., completes people's sentences; cannot wait for turn in conversation).

8. Often has difficulty waiting his or her turn (e.g., while waiting in line).

9. Often interrupts or intrudes on others (e.g., butts into conversations, games, or activities; may start using other people's things without asking or receiving permission; for adolescents and adults, may intrude into or take over what others are doing).

2. Several inattentive or hyperactive-impulsive symptoms were present prior to age 12 years.

3. Several inattentive or hyperactive-impulsive symptoms are present in two or more settings (e.g., at home, school, or work; with friends or relatives; in other activities).

4. There is clear evidence that the symptoms interfere with, or reduce the quality of, social, academic, or occupational functioning.

5. The symptoms do not occur exclusively during the course of schizophrenia or another psychotic disorder and are not better explained by another mental disorder (e.g., mood disorder, anxiety disorder, dissociative disorder, personality disorder, substance intoxication or withdrawal).

*Specify* whether:

- Combined presentation: If both Criterion A1 (inattention) and Criterion A2 (hyperactivity-impulsivity) are met for the past 6 months.
- Predominantly inattentive presentation: If Criterion A1 (inattention) is met but Criterion A2 (hyperactivity-impulsivity) is not met for the past 6 months.
- Predominantly hyperactive/impulsive presentation: If Criterion A2 (hyperactivity-impulsivity) is met and Criterion A1 (inattention) is not met for the past 6 months.
- *Specify* if:
- In partial remission: When full criteria were previously met, fewer than the full criteria have been met for the past 6 months, and the symptoms still result in impairment in social, academic, or occupational functioning.

*Specify* current severity:

- Mild: Few, if any, symptoms in excess of those required to make the diagnosis are present, and symptoms result in no more than minor impairments in social or occupational functioning.
- Moderate: Symptoms or functional impairment between "mild" and "severe" are present.
- Severe: Many symptoms in excess of those required to make the diagnosis, or several symptoms that are particularly severe, are present, or the symptoms result in marked impairment in social or occupational functioning.

**TABLE -2 - Differences Between U.S. and European Criteria for ADHD or HKD**

| | **DSM-IV ADHD** | **ICD-10 HKD** |
|---|---|---|
| Symptoms | Either or both of following:<br>At least 6 of 9 inattentive symptoms<br>At least 6 of 9 hyperactive or impulsive symptoms | All of following:<br>At least 6 of 8 inattentive symptoms<br>At least 3 of 5 hyperactive symptoms<br>At least 1 of 4 impulsive symptoms |
| Pervasiveness | Some impairment from symptoms is present in >1 setting | Criteria are met for >1 setting |

According to ICD – 10 hyperkinetic disorders are included under F – 90, in four sub categories as follows,

F 90.0 Disturbance of activity and attention

F 90.1 Hyperkinetic conduct disorders

F 90.8 Other hyperkinetic disorders

F 90.9 Hyperkinetic disorder, unspecified.

**Clinical Interview and History**

The clinical interview allows a comprehensive understanding as to whether the symptoms meet the diagnostic criteria for ADHD. During the interview, the clinician should gather information pertaining to the history of the presenting problems, the child's overall health and development, and the social and family history. The interview should emphasize factors that might affect the development or integrity of the central nervous system or reveal chronic illness, sensory impairments, or medication use that might affect the child's functioning. Disruptive social factors, such as family discord, situational stress, and abuse or neglect, can result in

hyperactive or anxious behaviors. A family history of 1st-degree relatives with ADHD, mood or anxiety disorders, learning disability, antisocial disorder, or alcohol or substance abuse might indicate an increased risk of ADHD and/or comorbid conditions[114].

**Behavior Rating Scales**

Behavior rating scales are useful in establishing the magnitude and pervasiveness of the symptoms, but are not sufficient alone to make a diagnosis of ADHD. There are a variety of well-established behaviors rating scales that have obtained good results in discriminating between children with ADHD and control subjects. These measures include, but are not limited to, the Vanderbilt ADHD Diagnostic Rating Scale; the Conner Rating Scales (parent and teacher); the ADHD Index; the Swanson, Nolan, and Pelham Checklist (SNAP); and the ADD-H: Comprehensive Teacher Rating Scale (ACTeRS). Other broadband checklists, such as the Achenbach Child Behavior Checklist (CBCL) or Behavioral Assessment Scale for Children (BASC), are useful, particularly in instances where the child may be experiencing co-occurring problems in other areas (anxiety, depression, conduct problems). Some, such as the BASC, include a validation scale to help determine the reliability of a given observer's assessment of the child.

**Physical Examination and Laboratory Findings**

There are no standard laboratory tests available to identify ADHD in children. The presence of hypertension, ataxia, or a thyroid disorder should prompt further diagnostic evaluation. Impaired fine motor movement and poor coordination and other **subtle neurologic motor signs** (difficulties with finger tapping, alternating movements, fingerto- nose, skipping, tracing a maze, cutting paper) are common, but they are not sufficiently specific to contribute to a diagnosis of ADHD. The clinician should also identify any possible vision or hearing problems.

The clinician should consider testing for elevated lead levels in children who present with some or all of the diagnostic criteria, if these children are exposed to environmental factors that might put them at risk (substandard housing, old paint, proximity to a highway which led to deposition of lead in the topsoil from automobile

exhaust years ago). Behavior in the structured laboratory setting might not reflect the child's typical behavior in the home or school environment.

Therefore, reliance on observed behavior in a physician's office can result in an incorrect diagnosis. Computerized attentional tasks and electroencephalographic assessments are not needed to make the diagnosis, and compared to the clinical gold standard they are subject to false-positive and false-negative errors. Nonetheless, the FDA has approved the Neuropsychiatric EEG-Based Assessment Aide (NEBA) system, which may identify an abnormal theta : beta wave ratio associated with ADHD.

**Differential Diagnosis**

Medical conditions like hearing loss, thyroid dysfunction, visual disturbances, some genetic disorders, seizures disorders and few allergic conditions may be considered in the differential diagnosis. Mental disorders like Tourette's disorder, oppositional defiant disorder, conduct disorder, anxiety and depressive disorders, pervasive developmental disorder not otherwise specified, obsessive—compulsive disorder and schizophrenio are to be ruled out. Very often it is seen that these children get to be highly sensitive and conscious of their poor performance in school. Behavioral problems like night terrors and sleep difficulties, coordination problems, enuresis and articulation problems may be seen in these children.[115]

Chronic illnesses (migraine headaches, absence seizures, asthma and allergies, hematologic disorders, diabetes, childhood cancer) affect up to 20% of children in the U.S. and may impair children's attention and school performance, either because of the disease itself or because of the medications used to treat or control the underlying illness (medications for asthma, steroids, anticonvulsants, antihistamines) [see Table-3]. In older children and adolescents, **substance abuse** may result in declining school performance and inattentive behavior.

**Sleep disorders,** including those secondary to chronic upper airway obstruction from enlarged tonsils and adenoids, frequently result in behavioral and emotional symptoms, although such problems are not likely to be principal

contributing causes of ADHD. Behavioral and emotional disorders may cause disrupted sleep patterns.

Depression and anxiety disorders may cause many of the same symptoms as ADHD (inattention, restlessness, inability to focus and concentrate on work, poor organization, forgetfulness), but may also be comorbid conditions. Obsessive-compulsive disorder may mimic ADHD, particularly when recurrent and persistent thoughts, impulses, or images are intrusive and interfere with normal daily activities. Adjustment disorders secondary to major life stresses (death of a close family member, parental divorce, family violence, parental substance abuse, a move) or parent-child relationship disorders involving conflicts over discipline, overt child abuse and/or neglect, or overprotection may result in symptoms similar to those of ADHD.

Although ADHD is believed to be due to primary impairment of attention, impulse control, and motor activity, there is also a high prevalence of comorbidity with other psychiatric disorders (see Table 31-3 ). The National Institute of Mental Health reported that 15–25% of children with ADHD also have learning disabilities; 30–35% also have language disorders; 15–20% are also diagnosed with mood disorders; 20–25% have coexisting anxiety disorders; and children diagnosed with ADHD may also have co-occurring diagnoses of sleep disorders, memory impairment, and decreased motor skill function[116].

**TABLE -3 -- Differential Diagnosis of Attention-Deficit/Hyperactivity Disorder (Including Coexisting Disorders)**

| | **COEXISTING CONDITIONS WITH POSSIBLE ATTENTION-DEFICIT/HYPERACTIVITY DISORDER** |
|---|---|
| **DIMENSIONAL FACTORS** | **PRESENTATION** |
| Behaviors are within the spectrum of normal | Oppositional-defiant disorder |
| Behaviors are problematic, but fall short of meeting the full criteria for diagnosis | Anxiety disorders |
| | Conduct disorder |
| | Depressive disorders |
| | Learning disorders |
| | Language disorders |
| | **DIAGNOSES WITH ASSOCIATED ATTENTION-** |
| **PSYCHOSOCIAL** | **DEFICIT/HYPERACTIVITY DISORDER BEHAVIORS** |
| Response to physical or sexual abuse | Fragile X syndrome |
| Response to inappropriate parenting practices | Fetal alcohol syndrome |
| Response to parental psychopathology | Pervasive developmental disorders |
| Response to acculturation | Obsessive–compulsive disorder |
| Response to inappropriate classroom setting | Tourette syndrome |
| | Attachment disorder |
| | Psychosis or schizophrenia |
| | Adjustment disorder with mixed emotions and conduct |
| **MEDICAL** | **NEUROLOGIC** |
| Thyroid disorders (including general resistance to thyroid hormone) | Auditory and visual processing disorders |
| | Seizure disorder |
| Heavy metal poisoning (including lead) | Neurodegenerative disorder |
| Adverse effects of medications | Post-traumatic head injury |
| Effects of abused substances | Postencephalitic disorder |
| Sensory deficits (hearing and vision) | |

**Management**

A description of the problem behaviors in specific situations and environments should be elicited. A history of aggression and fears, poor relationships with peers, academic difficulty, behavioral problems at school and reaction to authority, define the breath of the problem and provide useful information about the ADHD. Improvement and good outcome is possible if their parents and teachers provide understanding and direction and preserve the child's self esteem. Many of these children improve attention span as they grow but remain restless even in adulthood. Recent research indicates, that children with ADHD treated with multiple therapies (medication, and parent counseling) are less likely to present with delinquency in adolescence. This is a chronic condition and needs special intervention by parent, school and the doctor. The main focus of management would be to organize life and discipline[117].

**Home Management**

Parent counseling helps them to understand the problem, accept the child's condition and tell them that the hyperactive behavior is not intentional, attempts to change an energetic child into a quiet socially acceptable may prove to be difficult. These children need to be provided with outdoor activities; play with minimal instruction would be beneficial. These children need to organize to get adequate sleep and rest. A structured home schedule for daily activities like wakeup time, meal time, bed time, etc. should be followed with consistency. These children need a carefully planned discipline to be followed. Aggressive behavior such as biting, hitting, pushing should not be tolerated. All risks must be enforced with nonphysical punishment. Overwhelming situations such as big gatherings should be avoided till child learns to control himself. Structured behavioral modification program for increasing attention span, proper disciplining should be adopted. Child on special program in school would be beneficial.

**Dietary Management**

The idea that behavior disorder may be caused by food is largely suggested by Dr. Feingold. He saw 30 to 50 percent of hyperactive children show a significant

improvement when placed on a special elimination program of avoiding naturally occurring salicylates and artificial food additives, particularly in hyperactive children with a genetically predetermined predisposition. Although this has not been conclusively proved, it is worthwhile trying a diet based on wholesome food and avoiding foods with artificial color or flavor.

**TREATMENT [118]**

**Psychosocial Treatments**

Once the diagnosis of ADHD has been established, the parents and child should be educated with regard to the ways in which ADHD can affect learning, behavior, self-esteem, social skills, and family function. The clinician should set goals for the family to improve the child's interpersonal relationships, develop study skills, and decrease disruptive behaviors.

**Behaviorally Oriented Treatments**

Treatments geared toward behavioral management often occur in the time frame of 8–12 sessions. The goal of such treatment is for the clinician to identify targeted behaviors that cause impairment in the child's life (disruptive behavior, difficulty in completing homework, failure to obey home or school rules) and for the child to work on progressively improving his or her skill in these areas. The clinician should guide the parents and teachers in implementing rules, consequences, and rewards to encourage desired behaviors. In short-term comparison trials, stimulants have been more effective than behavioral treatments used alone; behavioral interventions are only modestly successful at improving behavior, but may be particularly useful for children with complex co morbidities and family stressors, when combined with medication.

**Medications**

Methylphenidate (Ritalin), dextroamphetamine, magnesium pemoline and tricyclic antidepressants are efficacious in reducing overactivity, increasing attention span, improving interaction between the child and the mother. The long-term benefits of these medicines have not yet been established. Methylphenidate is most commonly

used stimulant, it is efficacious in 75 to 80 percent of patients when administered in a dose ranging from 0.3 to 1 mg/kg 4 hourly. Dextroamphetamine is efficacious in 70 to 75 percent of patients. Dose is 0.2 mg/kg. Magnesium pemoline is used in the dose of 19 mg stat and later ½ tablet per week.

Children on any of these drugs must have liver functions to be monitored. Clonidine and tricyclic antidepressants are said to be effective in some children. Major short-term side effects include anorexia, abdomen pain and insomnia. Longterm use may result in increased heart rate and growth suppression. Drug therapy must be planned by only those who handle child with an understanding of the condition, and monitored regularly.[117] Stimulant drugs used to treat ADHD may be associated with an increased risk of adverse cardiovascular events, including sudden cardiac death, myocardial infarction, and stroke in adults and rarely in children. In some of the reported cases, the patient had an underlying disorder, such as hypertrophic obstructive cardiomyopathy, which is made worse by sympathomimetic agents.[120]

It should be noted that medication alone is not always sufficient to treat ADHD in children, particularly in instances where children have multiple psychiatric disorders or stressed home environments. When children do not respond to medication, it may be appropriate to refer them to a mental health specialist. Consultation with a child psychiatrist or psychologist may also be beneficial to determine the next steps for treatment, including adding other components and supports to the overall treatment program. Nonetheless, evidence suggests that children who receive careful medication management, accompanied by frequent treatment follow-up, all within the context of an educative, supportive relationship with the primary care provider, are likely to experience behavioral gains for up to 24 months.[120]

**PROGNOSIS**

A childhood diagnosis of ADHD often leads to persistent ADHD throughout the life span. From 60–80% of children diagnosed with ADHD continue to experience symptoms in adolescence, and up to 40–60% of adolescents exhibit ADHD symptoms

into adulthood. In children diagnosed with ADHD, a reduction in hyperactive behavior often occurs with age. However, other symptoms associated with ADHD can become more prominent with age, such as inattention, impulsivity, and disorganization, and these exact a heavy toll on young adult functioning. A variety of risk factors can affect children with untreated ADHD as they become adults. These risk factors include engaging in risk-taking behaviors (sexual activity, delinquent behaviors, substance use), educational underachievement or employment difficulties, and relationship difficulties. With proper treatment, the risks associated with the disorder can be significantly reduced[120]

**PREVENTION**

Parent training can lead to significant improvements in preschool children with ADHD symptoms, and parent training for preschool youth with ADHD can reduce oppositional behavior. To the extent that parents, teachers, physicians, and policymakers support efforts for earlier detection, diagnosis, and treatment, prevention of long-term adverse effects of ADHD on affected children's lives should be reconsidered within the lens of prevention. Given the effective treatments for ADHD now available, and the well-documented evidence about the long-term effects of untreated or ineffectively treated ADHD on children and youth, prevention of these consequences should be within the grasp of physicians and the children and families with ADHD for whom we are responsible[120].

## AYURVEDIC VIEW

*Ayurveda* considers human life as part and parcel of nature. Entire universe is made up of five basic elements known as *Pancamahābhūtas*. The coordinated interaction of these elements controls all the functions in creation. While the *Pancamāhabhūtas* represent the materialistic contribution, the functional aspect is explained by their dynamic combinations-the *Tridoshas*. An equilibrium condition of these factors are said to be the causative factors for health and their derangement for ill health.

The diseases are as old as man and a system of health that only takes into account the structure and functioning of the body cannot effectively address human health in its totality. *Āyurveda* asserts that health or ill health, comfort or discomfort arises first in the mind, which is the controller of the senses and the body and is ultimately responsible for the maintenance of harmony between the parts of human life and the universal intelligence that orchestrates life. So *Manas* is having central importance here.

ADHD can be considered as one of the *Manasa vikara* which is globally discussed worried and wide spread. ADHD is the most common neurobehavioral disorder of childhood. It is the most prevalent chronic health conditions affecting school-aged children. It is the extensively studied mental disorder of the childhood.

Ayurveda has been reputed for its management of psychological diseases. Thus it is worthwhile to understand the functioning of *Manas* in the context of the disease ADHD which will be of prime- importance in understanding its psychopathology.

Thousands of years back same was already explained in the science of Ayurveda as *'Samadosha samagnicha samadhatu malakriyaha, prasannatmendriya manah swasthabhidhiyate'.* – In this context a great importance is given to *Manas*. Same is discussed in WHO's definition of health as – 'Health is not merely a state of physical wellbeing and also social and mental wellbeing'.

Relation between body and mind, Ayurveda emphasizes that *Sharira* and *Satva* –both interacts with one another in all areas of life. It establishes that the *Ayurvedic* approach to the disease is definitely psychosomatic in nature.

It has been shown that somatic humors also affect the psychic conditions.

**CONCEPT OF MANAS**

*Manas, Ātmā and Śarīra* –are the pillars of the tripod of life. The world is sustained by their combination and they constitute the substratum for everything. *Manas* is mentioned first in the sequential order because it occupies very important place in this trio as the entire activities relating the body are controlled by it.

According to *Charaka:*

'That which is responsible for the presence or absence of cognition is called *Manasa.*'

*CharakaAcharya* says that *Manas* is one of the nine *Dravyas.*

*Manas* is *Ubhayatmaka* and *Atindriya.*

*Manas* is *Achetana* but *Kriyavana.*

After *Sannikarsha* of *Atma*, *Indriya* and *Artha*, the main factor whose presence or absence determines the *Gnanotpatti* that is *Manas.*

Thus we can find that *Manas* itself is a faculty but it is considered as a super faculty because it controls and co-ordinates all other faculties and they can get connected to the soul only through the *Manas.*

According to vishnupurana:

The mind is the cause of bondage and freedom. To be entangled in desires is the cause of bondage and desirelessness is the cause of freedom from worry, disease and distress – Salvation *(Moksha).*

Even though, there is no detailed description regarding *Manovaha Srotas* available in classics, but *"Manovaha Srotamsi", "Chetanavaha Srotas",* - such words do appear in classics.

*Raja* and *Tama* are the *Doshas* of *Manasa,* which vitiates the *Manovaha Srotasa* along with *Sharirika Doshas.*

Accoding to Yogasutra

The modification of mind or its fluctuation includes all types of awareness, impulses and affections; they are called *Chittavrittis* and are classified as follows -

1. *Kshipta* : Distracted natures – restless minds.

2. *Vikshipta :* Unsteady mind – occasionally steady.

3. *Mudha :* Stupid and passionate – self assertive.

4. *Ekagra :* Attentive positions or concentrated minds.

5. *Niruddha :* restricted tempers or the restricted minds.

These five *Chittavrittis* denotes the different kinds of mental fluctuations. Any deviation in these fluctuations also leads to *Manasa vikaras.*

In the disease ADHD, all the *Chittavrittis* are deviated for example

*Kshipti* – restlessness or hyperactivity

*Vikshipta* – unsteadyness or impulsive

*Mudha* – stubbornness

*Ekagra* – concentration –no concentration, in attentive or attention deficit

*Nirudha* – restricted mind – no restriction or control in behavior, like this all

*Chittavrittis* are altered in ADHD.

*Buddhi* - the characteristic of *Atma,* influences *Manasa* through

Its three dimensions are

*Dhee :* Proper judgement

*Dhriti :* Controlling power

*Smriti :* Recall or memory – any deviation in these 3 factors also leads to disease

## *MANOVYAPARA* IN THE CONTEXT OF ADHD

### The *Karma* of *Manas* [1]

The description of *Manas* and *Manovyapara* given by *Charakacharya* includes various phases or a series of various intermediary functions. The ultimate outcome of this *Manovyapara* is *Buddhi* or the knowledge.

Clarity of this phenomenon of knowledge production is very essential for the normalcy of the behavior of a person, because *Buddhi* is an essential factor for motivating an individual to behave in a proper manner.

In Attention deficit / hyperactivity disorder, the children with combined ADHD have inappropriate restlessness, behavioral and cognitive impulsivity and difficulty paying attention. They have a hard time controlling their impulses and regulating their activity, attention, interaction to a degree consistent with relevant age and cultural norms. In brief this picture of the disease gives a glimpse of the defects in the volitional power of the *Manas* i.e. the *Buddhi* or the *Prajna*, its constituents, the *Dhee*, *Dhriti* and *Smriti* and that in the functions of the *Manas.*

*Acharya Charaka* has included *Indriyabhigraha, Swanigraha, Chinta, Uha Vichara* and Production of *Buddhi* as the functions or *Karmas* of *Manas.*

When analyzed with reference to the genesis of *Buddhi*, these functions appear to be stages of this phenomenon of production of *Buddhi.*

***Indriyabhigraha :***

*"Abhigraha"* means to "Catch" or "Seize". In the context of production of knowledge it means to remain in conjugation with the sensory organs to perceive its objects. These sensory organs themselves are not capable of functioning without their union and appropriate association of *Manas.*

***Swanigraha :***

The literal meaning "*Swanigraha"* is controlling the self. This is another important function of the *Manas* and very crucial step in the genesis of knowledge.

*Acharya Chakrapani* has explained this further that when the *Manas* get involved in the *Anishtavishayas*, it is detracted or controlled by the *Manas* itself. In this reference he quotes that *Swanigraha* is a phenomenon in which *Manas* when in contact with one *Artha*, detracts itself from the other *Arthas.*

*Dhriti* is the controlling factor of *Manas.* Function of *Dhriti* is to divert the mind from irrelevant matter and guide towards the relevant. When a person is under the influence of *Dhriti bhramsha*, he will not be able to detract the mind from the harmful or irrelevant objects. This explains that the impulsive nature, abnormal behaviors inappropriate to situations is a result of abnormal *Swanigraha.*

***Vichara:***

This means the ability of mind "to think over". Since this term has been used in a technical sense, *Acharya Chakrapani* has stated that *Vichara* is the *Vikalpana* or critical analysis where *Heyata* (uselessness) or *Upadeyata* (usefulness) of any object is decided.

Abnormalities of *Vichara* will prevent the *Manas* from taking decisions or thinking over the good and bad consequences of particular actions. Attention will also be affected as the ability to select a useful object for concentration will be lost, and mind will be prone for wandering and wrong decision-making.

***Manoarthas :***

*Manoarthas*, better called the *Manovishayas*, are the aspects that require *Manas* for their analysis and interpretation.[2]

*Chintya :* Primary thought given to the worthiness of doing a thing or otherwise.

*Vicharya :* Requiring critical analysis about rightness or otherwise.

*Uhya :* Judgement or guessing

*Dhyeya :* Continuous thinking about the desired things

*Samkalpa :* Requiring determination or about which merits and demerits are considered.

*Manovishayas* are the one, which do not require *Indriya* for their perception as they originate directly at the seat of *Manas.* Critically reviewed these *Arthas* are pivotal in the thought processes, aim fixing, task completion i.e. some of the major determinants of behavioral patterns. Thus eccentricity of *Manovishayas* can lead to behavioral abnormalities like ADHD.

***Tridoshas* and their effect on *Manas :***

*Tridoshas,* the bodily humours are the major physiological determinants of normal functioning of the body as well as that of the diseased condition.[3]

These *Doshas a*nd their physiological variants exert their influence not only at the level of body but also at the level of mind and its higher intellectual functions. The description of the same is given as follows.

***Vata*[4]**

*Prana vayu* is responsible for controlling the functions of *Buddhi* and *Manas. Udana Vayu* helps in recalling the past experiences i.e. *Smriti.* Speech and motivation are also under the influence of *Udana Vayu, Vyana Vayu* controls the functions of various *Karmendriya* mainly of *Hasta* and *Pada.* All the bodily movements are controlled by *Vyana.*

***Pitta*[4]**

Function of *Pitta* is to promote *Medha. Sadhaka Pitta* is mainly responsible for *Medha, Buddhi* and *Abhimana*

*Acharya Bhela* has depicted two types of *Alochaka Pitta* as (1) *Chakshuvaisheshika (2) Buddhivaisheshika.* The *Buddhivaisheshika Alochaka Pitta* has been attributed the functions like retaining the acquired skills, knowledge, memory, power of intuition etc.

***Kapha*[4]**

*Tarpaka* and *Avalambaka Kapha* in their normal state confer the knowledge and intelligence. *Kapha* is also responsible for the best qualities of *Dhriti*. Due to their

significant contribution in many of the higher intellectual functions, the *Sharira doshas* when vitiated eventually vitiate these functions of the mind.

***Manodoshas** :*

*Acharya Charaka* and *Vagbhata* have considered *Tama* and *Raja* as the *dosha* of the *Manas* and have included *Sattva* as a guna.[5] They are having unbreakable relation with each other because *"Tamas"* cannot act without the help of *"Rajas"* (*Ch.Vi. 6/9). Manasika Doshas* generally vitiates *"Manasa"* leading to various psychological disorders. Thus, *"Rajas"* and *"Tamas"* must be sufficiently strong to vitiate *"Manasa",* and then only the respective *Manas Vikaras* can be produced.

References of *Manasa vikaras* mentioned in various texts (*Ch. Vi. 6/5, Su. Su. 1/33)*

*Kama* (passion), *Krodha* (anger), *Lobha* (greed), *Moha* (infatuation), *Irshya* (grief), *Mada* (arrogance), *Shoka* (grief), *Chittodvega* (anxiety), *Bhaya* (fear), *Harsha* (exhilaration), *Vishada* (depression), *Dainya* (affliction), *Matsarya* (jealousy).

Description of abnormal behaviour though are found scattered in our texts like –

*Anavasthita Chittatva* – Ch. Su. 20/11
*Manovibhrama* – Ch. Ni. 7/5
*Buddhivibhrama* – Ch. Ni. 7/5.
*Smritivibhrama* – Ch. Ni. 7/5
*Sheelavibhrama* – Chi. Ni. 7/5
*Cheshtavibrama* – Ch. Ni. 7/5

A balance of these three temperaments results in the normalcy of behavior while their imbalance results in otherwise. The variations in human behavior are also contributed by the variations in proportional ratios of three temperaments with each other. Even in the same individual the momental expression of any of these temperaments may result in expression of various emotions at different times.[6]

The 3 types of *Manasa prakriti* have been described along with their most commonly found variants. But *Charakacharya* elucidated that their types are innumerable due to the normal variations which occur in them due to age, race etc. In

the context of ADHD it is important to focus on the concept of the balance of these *Manodosha* and *Guna.* When this balance disrupts, it leads to abnormal behavioral patterns.

A brief account of the qualities of *Manodoshas* is as follows:

***Rajodosha***

Due to the *Roshamshattva, Rajodohsa* has been called as *Sadosha*. It is responsible for vigor, expression of emotions and motivation. The egoistic type of emotions like fear, anger, hope, envy, prudent, pride etc. are due to *Rajo guna.*

***Tamo dosha***

It is known as *Avaranatmaka* and has *Mohamsha* i.e. it has got characteristics of covering or concealing and is *Vishadatmaka* i.e. depressive in nature. The unawareness, effortlessness is due to Tamodosha. But due to its heaviness, some amount of *Tamodosha* is required for enduring stability to *Manas.*

**Faculties related with *Manas***

*Dhi, Dhṛti,* and *Smṛti* are the three main faculties, which are closely related to *Manas.*

It is very interesting to notice that, *Charaka Acharya* has given the description of the *Buddhi* or *Prajna* and its components - *Dhee, Dhriti*, and the *Smriti* in the context of abnormal behaviors. These abnormal behaviors enlisted under the heading of *Prajnaparadha* have been included under the three principle precipitating factors of a disease and the description of *Prajnaparadha* bears much similarity with the description of hyperactive impulsive behavior.[7]

The components of *Prajna* are key factors in the genesis of knowledge and defects in which lead to various mental disorders. Applied aspects of these are as given below.

***Dhee*** [7]

*"Dhee jnanam"*

*"Dhee prajna"*

*Dhee* is a type of *Prajna* (Intellect) and its function is to take correct decision or Judgment or Discrimination.

*Charakacharya* described it as *"Samam Buddhirhi Pashyati*" . *Acharya Chakrapani* explained this as the knowledge of an object „in the sense of as it is, known as *Dhee,* in other words it is the perception of true knowledge. It is also called as *"Uchita Buddhi"* and *"Yathartha anubhava".*

In *Charaka samhita,* terms like *Buddhi, Mati, Medha, Pragna,* and Jnana are frequently used for intellect. *Buddhi* is defined as a phenomenon by which knowledge is gained *"Budhyate anena iti buddhi"*. *Chakrapani* states that *Buddhi* gives an initiative for work to come to final conclusion, after proper analysis.[8] *Arunadatta* explains, *"Buddhi adhyavasaya roopa",* which means it executes the work after looking for pros and cons.

Thus *Dhee* is a faculty related with higher order of cognition which is responsible for processing of the perceived data, its critical analysis, thinking, reasoning, concept forming ultimately resulting in true knowledge and experience.

Thus *Dhee* is very important for the formation of complex thoughts, following through chain of thinking, and decision making which will determine the behavior of individual. In *Dhee Vibhramsha* the person unable to recognize what is good for him or what is bad and what is relevant and what is irrelevant etc. In ADHD also due to poor attention the child would continually respond to irrelevant stimuli and not be efficient in functioning.

***Dhriti*[9]*:***

*"Dhṛtirhi Niyamātmika"*

It is the power of will, which control manas from the various visayas or temptations of surroundings. *Chakrapani* commented *Dhriti* as,

- *Niyamaatmika*
- *Niyanta*

Our minds are unable to attend to every sight, sound, smell, thought, memory and action impinging on us at any given moment (*Ekatva* of *Manas).* Control refers to a person's ability to guide the selective process by directing and organizing whatever attentional capacity is available. Normal mental functioning requires an individual to select a limited number of stimuli to be processed at any given moment.

The basis for selection needs to be maintained over sufficient time periods to provide coherence to both thought and action. Here control of attention resembles with the *Niyamana* function of *Dhriti.*

*"Dhritim aloulyena"*

Here *Dhriti* means "*Firmness*", the ability to be within the norms of righteousness.

The level of attention requires the ability to maintain a behavioral or cognitive set in the face of distracting or competing stimuli. Sustained attention resembles with *"Mano Niyamaatmika"* function of *Dhriti.*

*Chakrapani* explains the *Svaroopa* (Nature) of *Dhriti* as

- *Akaryaprasaktam* - Irrelevant stimulus or focus
- *Nivartayati* - Diversion

So *Dhriti* diverts the mind from irrelevant focus or stimuli to relevant focus or stimuli. This function of *Dhriti* is resembles with "Selective attention" or "focused attention".

*Dhriti* has been described as a controlling factor, which prevents the *Manas* from indulging in harmful and non-beneficial objects. Indulgence in useless and harmful activities occurs when the conscious mind is not under the control of *Dhriti* due to *Dhritibhramsha.*

*Dalhana* has mentioned that control over the mind is possible only on the basis of retained experiences whether that object is useful or not *"Dhṛti Manaso Niyamātmikā Buddhi"*[10].

The description of impulsivity has been given as the inability to delay a response despite the anticipation of negative consequences for the behavior. It is quite evident from the description of *Dhriti* that inattention and impulsivity is the consequence of *Dhritibhramsha.*

***Smriti :***

*Acharya Charaka* has called *Smriti* as remembrance of *Tattva Jnana*.[11]

The recollection of previously acquired knowledge is very essential for the adequacy of perception. The recollection whatever is seen, heard, experienced is called as *Smriti.* All these components of *Buddhi* are crucial for the genesis of Knowledge.

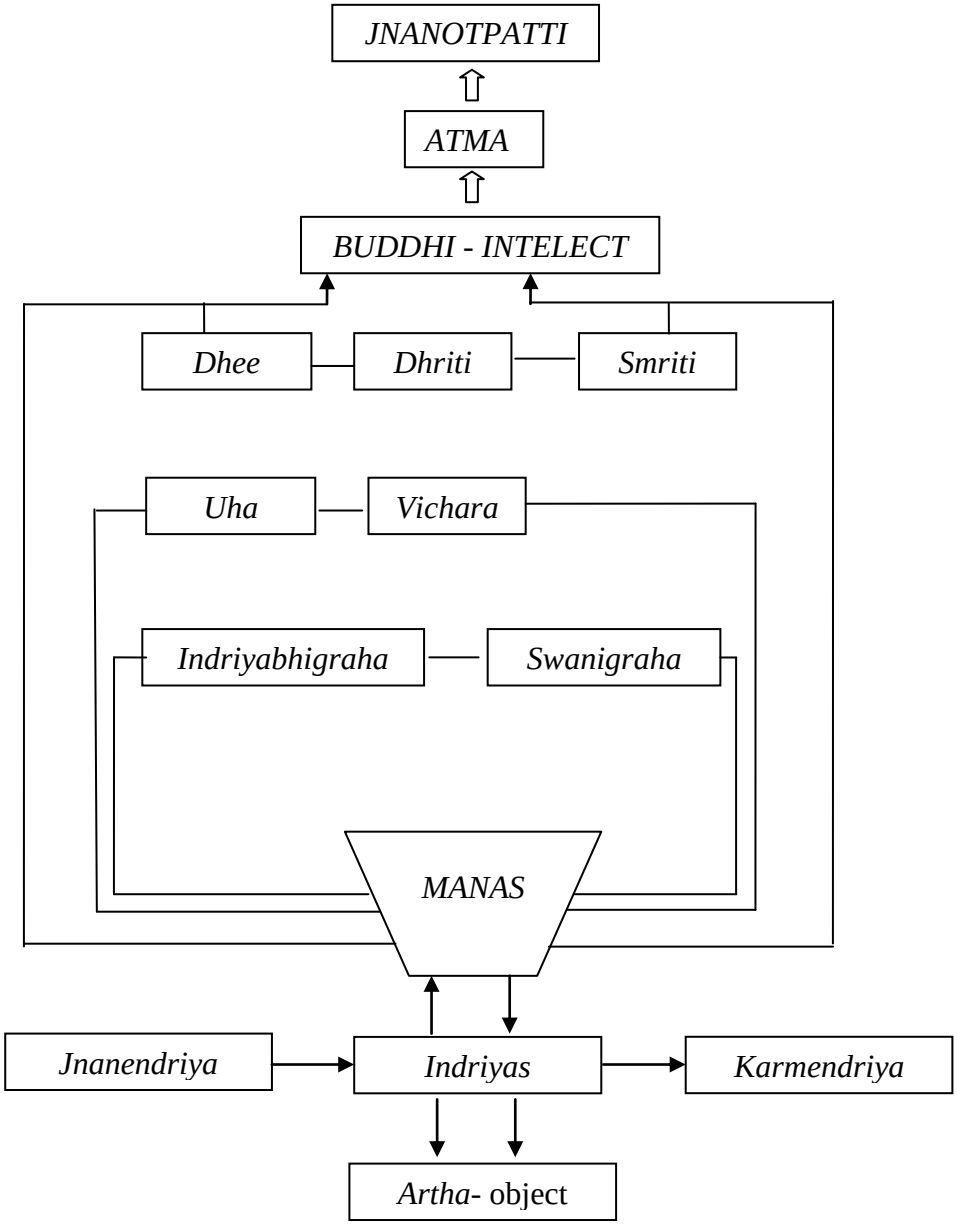
**PROCESS OF GENESIS OF KNOWLEDGE - *JNANOTPATTI* AND ITS APPLIED ASPECT IN THE CONTEXT OF ADHD**

To make the understanding of various stages of the *Jnanotpatti*-its pathways and factors involved in it- easier, a schematic representation of it is given below.

The *Darshanika* concept of knowledge genesis has been described as the *Atma* unites with the *Manas*, the *Manas* unite with the *Indriya* and the *Indriya* in turn unite with the *Arthas* and result in the production of knowledge (*Nyaya Darshana*). This description is incomplete, as the complex intermediate stages are not mentioned. On the contrary, *Charakacharya* has narrated the whole phenomena and termination or conversion of the knowledge into action in the context of describing the function of *Manas.*[11]

The first stage is the perception of *Indriyarthas* through the *Jnanendriyas* associated with the *Manas* and this has been correlated with the Indriyabhigraha as well as the *Uha.* The functions of *Indriyabhigraha* and *Swanigraha* are important at this phase both for perceiving object of one single *Indriya* with due concentration and for selecting the right kind of object for perception. There is a continuous backup of *Dhee, Dhriti* and *Smriti* during all the stages of the genesis of knowledge.

**CHART-1**




The second stage deals with the *Kalpan* i.e. consideration of merits and the demerits and this incorporates the *Vichara* function of the *Manas* and in the third stage, the production of "*Nischayatmika Buddhi*" occurs. At this stage a final decision of indulgence or non-indulgence into the object is taken.

The last stage is the transformation or termination of knowledge into action and regarding this transformation or termination, *Charakacharya* says that on the basis of the decision arrived at through the "*Adhyavasaya*", a living organism indulges

in the bodily action or the vocal action. The whole process of perception, genesis of knowledge is a comprehensive description of higher order of cognition. And this is a determinant of the behavior of the individual.

In the context of ADHD, the entire spectrum of the clinical presentation of the disease can be comprehended by understanding this process. The role of each of the factors involved in this process has been elaborated previously. From the stage of perception, generalization and then action, any defect in the function of any factor and or defect in the pathways of these functions will lead to erroneous genesis of knowledge. This will lead to violations of the normal behavior leading to *Prajnaparadha.* Depending on the permutations and combinations of various defects in this genesis of knowledge various diseases of *Manas* will result like ADHD in which capacity to concentrate, to control ones actions and reactions is diminished or lost.

## GLIMPSES OF ABNORMAL BEHAVIORS IN *SHARIRIKA* AND *MANASA PRAKRITI*

The word *Prakriti* has been used in different meanings in different contexts. But in the context of rationalizing the description of certain abnormal behavioral pattern under the heading of *Prakritis, Acharya Charaka's* concept about the normal and abnormal *Prakritis* is worth noting. Except *Sama Prakriti, Acharya* has called as all the other 6 variants of *Prakriti* to be abnormal as there is definite predominance of particular *Doshas* in them. Thus these different types cannot be considered as representing normal condition of health. Thus these inherited *Doshaja deha prakitis* are in some way abnormal and the individuals with these *"Vataladi" Prakritis* are always prone to and suffer from various diseases. A good number of psychic traits of *Prakritis* are described by the *Samhitas,* which point to the genetic predisposition of individuals to certain behaviors.

Characteristics of *Kapha Prakriti* are dominant in *Sattva* and *Tama guna* and show no apparent similarity with the description of an individual with ADHD so is not included here.

A brief tabulation of the abnormal psychic traits available in the texts is as given below.

**TABLE-5 Psychological traits in *Deha prakriti* in the context of ADHD**

***VATA PRAKRITI***

| S.no | Traits | Meaning |
|---|---|---|
| 1 | *Alpa smriti* [12] | Short memory |
| 2 | *Ayavastitamathi* [13] | Absent minded |
| 3 | *Anavastitatma* | Unsteady minded |
| 4 | *Bahubashi* | Taketive |
| 5 | *Chaladriti, mriti budddi*[14] | Unstable psychic faculty |
| 6 | *Krodha* | Anger a |
| 7 | *Najitendriy* | With out self control |
| 8 | *Nadridha* | Indefinity |
| 9 | *Pralapi* | Delirious |
| 10 | *Shigra raga virago* | Short temparament |

***PITTA PRAKRITI***[15]

| | | |
|---|---|---|
| 1 | *Kshipra kopa* | short tempered |
| 2 | *Sleshssahisnu* | Diminished adaptability |

By this description much insight can be achieved in the characteristics of hyperactivity, inattention and impulsivity, which is inherited. Since the *Dehaprakriti* as well as the *Manas prakriti o*f parents affects that of the fetus, such abnormal psychic traits in varying severity will be passed on to progeny. These along with other favorable etiological factors of ADHD can lead to manifestation of this disease in the children.

***MANASA PRAKRITI***

*Manas prakriti* or the *Sattva* is also formed during the conception itself. *Sharira* and *Manasa prakriti* both influence each other. The description of *Sattvika manas prakriti* is that of an ideal and socially accepted behavior.

*Acharya Charaka* has called *Sattvika Prakriti* as *Shuddha Sattva* while that of *Rajasika* and *Tamasika Manas prakriti* involves a description of abnormal behaviors.

A tabulation of variants of *Rajasika* and *Tamasika Prakritis* is as given below.

***RAJASA PRAKRITI***

***Asura Sattva -*** *Raudra* - Terrifying temperament

***Rakshasa Sattva -*** *Amarshina* – Intolerant, *Anubandhaka* - merciless anger, *Krura* – Cruel

***Paishacha Sattva -*** *Bhisayita*rama - Making others dreadful, *Vikrita Vihara Ahara Sheela* - Abnormal activity and feeding habits

***Sarpa Sattva -*** *Bahu vairanam* - One who makes enemies due to his behavior.

***Preta Sattva -*** *Atidukhashilacharopachara* - Whose character and conduct are painful to others.

***Shakuna Sattva-*** *Amarshina* – Intolerant, *Anavasthita* - Fickle minded

***Bhuta Sattva -*** *Vikritatmano* – Abnormal psyche

***TAMASA PRAKRITI***

***Pashava Sattva-*** *Amedhasam* – Unintelligent

***Matsya Sattva***

*Abudham* – Stupid, dull person

*Anavasthitam* - Fickle minded

*Anushakta Krodha* - Always angry

*Saranashila* - Habitual wandering

*Parasparabhimarda* - Quarrel with each other

***Manasika Vikaras***

The external or internal factors that affect the normal functioning of *Manas* can lead to psychopathology and such pathological conditions of *Manas* are considered as *Manasika Vikaras.*

The factors which helps mind to take a stable, firm, and right decision with interest of having a healthy status of the body are *Dhee, Dhŗti, and Smriti.* Hence proper functioning of these three elements of *Manas* enables the mind to work at its best; in contrary, in the absence of the same, mind fails to make the right decision. This situation of mind is called as *Dhee, Dhŗti, and Smriti Vibramsha.*

Due to *Prajnaparaha (*indulging in wrong things knowingly) the *Manasika doshas* are vitiated leading to the derangement of the functions of *Manas* specifically in that of *Indriyabhigraha* and *Svanigraha* leading in *Vibhramsha* of *Dhee, Dhriti* and *Smrirti* and finally resulting in *Manasika vikaras* like- *Kama* (passion) , *Krodha* (anger), *Lobha* (greed), *Moha* (infatuation), *Irshya* (grief), *Mada* (arrogance)[16]. Though these terms have been mentioned collectively under the description of *Unmada Vyadhi,* when considered individually they closely resemble some of the clinical features and associated features of ADHD.

*Tridoshas,* and their types are the major physiological determinants of normal functioning of the body and mind as well as that of the diseased condition. As per Acharya Charaka *Vata Dosha* is the main controller and stimulant of *Manas*. The *Saririka doshas* (*Tridoshas*) and *Manasika doshas* are interrelated with each other. Disturbed *Manasabhavas,* play an important role in causing various *Sharirika Vyadhis* and in the same way vitiated *Saririka doshas* become etiopathogenesis for *Manasika Vyadhis*. For example, *Vayu i*s provoked by *Kama, Shoka, Bhaya*, thus causing vitiation of *Vata Dosha* and lakshanas like *Alpanidra, Anidra* are manifested.

Though there is no exact disease in Ayurveda that can be compared with ADHD, but the characteristics of the disease can be correlated with the abnormal presentations that are manifested due to disturbances in the normal functions of *Manas- Dhee, Dhriti, Smriti Vibramsha.*

**DISEASE REVIEW ADHD – AYURVEDIC PERSPECTIVE**

The description of diseases given in our classical texts was mainly based on:

(1) The diseases commonly prevalent in the society of that time period.

(2) The diseases which when explained would serve as a guideline for understanding pathophysiology of any other newly aroused disease condition in future.

*Charakacharya* clearly mentioned that -

Not all diseases can be named as their presentations vary depending on the causative factors of *dosha* vitiation and the pathogenesis of the disease in different parts of the body by these vitiated *doshas. Acharya* has thus clarified that description of every physical or mental disorder was out of the scope of our texts as diseases are innumerable.

**Classical description**

There is no clear-cut description of any disorder matching that of Attention deficit / hyperactivity disorder in ayurvedic texts. Description of abnormal behavior though are found scattered in our texts like –

*Anavasthita Chittatva*

*Manovibhrama*

*Buddhivibhrama*

*Smritivibhrama*

*Sheelavibhrama*

*Cheshtavibrama*

*Acharavibhrama*

Though these terms have been mentioned collectively under the description of *Unmada Vyadhi,* [17] when considered individually they closely resemble some of the clinical features and associated features of ADHD.

**NIDANA OF ADHD**

ADHD is a heterogeneous disorder. Keeping in mind the etiological factors and pathogenesis of the disease as described by contemporary sciences, the various *Nidana* occuring before and during pregnancy i.e. prenatally, natally and postnatally

which finally affects the behavioral integrity of an individual should be considered here.

They can be collectively given under the following headings.

Wide varieties of *Nidaanas* are mentioned for mental disorders in *Ayurveda*. For ADHD also multifactorial causation theory is accepted.

The *Nidaana* can be classified in to

*Nija* and

*Aagantuja.*

***NIJA NIDANA***

It refers to those *nidaana* that are responsible for *dosha* vitiation and then leading to the manifestation of disease. It can be further classified into

*Sahaja,*

*Garbhaja* and

*Jaataja*

***(1) SAHAJA NIDANA*-Genetic Factors**

***(a) Atmakarma***

While describing the causes of resemblance of the child to the parents, *Charakacharya,* mentions that the fetus is derived from four sources viz. mother, father, *Ahara* of the mother and one's own past actions and whichever source is most powerful is to be regarded as the determining factor of resemblance while the past actions are alone responsible for the *Sattva* (Psyche) of the child.[18]

**(b) *Atmaja* and *Sattvaja Bhavas***

These are the prenatal deterministic factors, which exist even before the conception occurs. They have their metaphysical and psychological existence and exert their influence on the coming individual.

***Atmaja Bhava**:*

Here the traits, which are passed on to the individual from *Atma*, are considered.

In the context of ADHD, the traits related to intellect and higher order psyche, which are passed from the *Atma,* are important. As in the full blown clinical presentation of the disease many of these traits are found to be functioning abnormally. So in a retrograde manner it may be derived that abnormally passed on traits may be the reason for this abnormal functioning.

The important psychic traits passed on from Atma are as follows.[19]

- *Prerana* - Inspiring capacity
- *Dharana* - Retention
- *Sukha Dukha* - Pleasure and pain
- *Iccha Dwesha* - Desire and aversion
- *Dhriti* - Resolution
- *Buddhi* - Understanding
- *Smriti* - Recollection
- *Ahamkara* - Egoism
- *Prayatna* - Effort

***Sattvaja bhava:***

While describing the variations in the psychic temperaments from individual to individual, *Charakacharya* has mentioned "*Sattvavaisheshyakara Bhavas"*. One of them is the *Matruja* and *Pitruja Sattva* - the various mental traits of the parents as being responsible for the psychological endowment of the children.[20] *Acharya* has also enumerated the traits that are passed on from *Sattva* to the child which influence the psychic temperament of the child. The following traits are salient in the content of the disease ADHD.

- *Bhakti* - Likings
- *Sheela* - Character
- *Dwesha* - Disliking, hatred
- *Smriti* - Recollection
- *Moha* - Confusion
- *Shaurya* - Courage
- *Krodha* - Anger
- *Utsaha* - Enthusiasm
- *Tikshnata* - Sharpness

As we see, these traits are purely psychological and are related to the emotional or behavioral aspects of life.

***(c) Related to Beeja, Beejabhaga* and *Beejabhagavayava:***

- The mother and father chiefly exert their influence in the makeup of the personality through *Shukra* and *Shonita*.[20]

- *Charakacharya* has described the abnormalities of micro fine constituents of these germ cells, (the *Shukra* and *Shonita*) the *Beeja, Beejabhaga* and *Beejabhagavayava* to be responsible for congenital deformities in the fetus.[21, 22] These basic constituents of the germ cells play a definite hereditary role in the determination of the individual. The researches in the field of genes and temperament have now shown that the ancestry of the individual gives clue to his temperament. Thus the *Manas prakriti* of the parents will influence the *Manas Prakriti* of the child. Out of three types *of Manas Prakriti - Sattvika, Rajasika* and *Tamasika,* the child who will inherit a *Rajasika Manas prakriti* will be *Anavasthita* – fickle minded.

- The *Dehaprakriti* of the parents also exerts its influence on the physical constitution of the child. The child which will inherit a *Vatika* type of *Deha prakriti* will have short span of memory *(Alpasmritayaha)* and will

be prone to hyperactive, impulsive and inattentive types of behavioral disorders.[21]

**(2) *GARBHAJA* (Antenatal factors)**

The Ayurvedists firmly believed that any event during the antenatal period would exert its influence on the growing fetus both physically as well as psychologically.

*Charakacharya* has mentioned *Matri Ahara* (diet of the mother), *Matuvihara* (conduct of the mother) and *Ashayadosha* (abnormalities of the *Garbhashaya)* as the antenatal factors causing deformities in the fetus.[21]

- Among the factors, which are responsible for psychic peculiarities in an individual, *Charakacharya* has included "*Antarvartnya Shrutayaschabhikshanam*"[20]. *Acharya Chakrapani* has explained it as whatever music etc. the mother hears; she will deliver a child of similar characteristics.

- There are so many such references in *Ayurveda* which reveal that behavior of the mother and her emotional state of mind during the period of pregnancy or at the time of conception are going to deliver their effects on the psychological constitution of the child.[23]

It is evident from the above given references that the concept of antenatal factors leading to unwanted fetal outcomes was quiet developed in *Ayurveda.*

Description of individual antenatal factors is given as follows:

***(a) Ashaya Dosha:***

This is one of the non-hereditary maternal factors, which gives a positive turn in the development of the individual.

- *Garbhashaya* is the place where the fetus resides for an average period of 9 months so it is natural that the normal or abnormal conditions prevalent in it should influence the fetus.

- Therefore *Kala* and *Garbhashaya Prakriti* have been enumerated as one of the factors, which determine the human constitution.

- As mentioned previously *Charakacharya* regards the uterine defects as one of the causes for the malformations of shape, color and the senses of the child.[24]

The probable reason behind considering *Garbhashaya* as one of the factors for fetal abnormalities may be due to the fact that the nourishment of the growing embryo will be improper in a deformed or defective *Ashaya.* This will result in improper physical a well as psychological development of the fetus.

***(b) Matu Ahara:***

A great amount of stress has been given by the Ayurvedists on the diet of the pregnant women to avoid any untoward effects on the growing fetus.

- She has been advised to follow the dietetics of the people of the region of which type she is desirous of having a child.[25]

- Whatever diet and regimen the pregnant woman adopts, the child will develop to be of the same qualities.

- Alcohol consumption by pregnant women would lead to short memory span *(Alpasmriti)* and inattention *(Anavasthitachitta)* in the child.[26]

- The fetus is said to grow from the essence of diet that mother takes through the processes of *Upasweda* and *Upasneha.*

  Therefore whatever diet the mother takes affects the fetus directly. This fact is well supported by the contemporary science that exposure to toxins, alcohol etc. during the antenatal period can lead to ADHD in the child.

***(c) Matu Vihara:***

Not only the diet but also the behavior of the mother, at the time of pregnancy, has got its own deterministic influence on the psychological development of the child.

- Various unwholesome regimens during pregnancy and their effects, which should be avoided by the women, are clearly mentioned in the texts.[26] Many of these adverse effects are clearly at psychological level.

- Behavior of the mother and her emotional state of mind during the period of pregnancy or at the time of conception influences the psychological makeup of the child.

- It has been proved even by the modern researchers that emotional disturbances during pregnancy affect the fetus. In mild maternal stress fetal activity and fetal heart rate increase. Severe and prolonged maternal stress lead to blood borne anxiety, which affects postnatal as well as prenatal development of the child. Such stress can lead to ADHD in the child.

Stress also upsets the normal functioning of the maternal endocrine system. These results in a hyperactive state of the thyroid and adrenal glands – the glands of the endocrine system that prepare the body for increased activity during an emotional state. These endocrine secretions are then transmitted to the prenatal environment in the uterus and result in a condition that affects the developing child.

**(4) *Dauhrida Vimanana*:**

When the indriyas develop in the fetus, the *Manas* of the growing *Garbha* starts revealing its desire through the mother and this phenomenon is called as *Dauhrida.*

- A Slight negligence on the part of non-fulfillment of mother's *Dauhrida* - cravings may result in some of severe repercussions in the development in the fetal life. In case of unfulfillment of *Dauhrida* a woman will give birth to a child who would be affected by deformities like lameness, defective vision, blindness or mental deficiency.[27]

- It is recognized that the whole organism remains in a stage of strain during pregnancy and a slight cause is sufficient to worsen it in the direction of abnormal depression and melancholia.

- The maternal cravings may be an indicative of various deficiencies in the mother, as certain deficiencies like Vitamin B12 lead to ADHD in the child.

**(3*) JANMOTTARA* – The Postnatal factors**

**(a) Effect of *Matridugdha*:**

*Kashyapacharya* has clearly mentioned that feeding with vitiated breast milk will lead to various diseases in the child.[28] *Vagbhata -I* have advised that breast milk of woman who is angry should be avoided. While *Vagbhata-II* has instructed that a woman with psychological abnormalities should not feed the child.

One of the reasons behind this was that Ayurvedists believed that the emotional status of a lactating mother affects the breast milk and the psyche of the child who is feeding on it eventually.[29]

Among the *Panchaksheeradosha* mentioned by *Acharya Harita*, *Alpaksheeradosha* can cause *Alpasattva* in the child and *Ushnaksheeradosha* may lead *Alpattva* at both physical and mental level in the child.

It has been proved by various research scholars that breast milk plays a major role in the mental development of the infant. It contains amino acids specific for brain development. It offers a high tryptophan to neutral amino acid ratio, which controls brain serotonin synthesis. And the imbalance of serotonin-dopamine relationship is one of the factors responsible for hyperactivity. So vitiated breast milk can be rightly considered as one of the factor for the disease.

**(b) *Asatmendriyartha Samyoga*** –

*Asatmendriyartha Samyoga* has been included under *Trividha rogayatan* i.e. three abodes of diseases by *Charakacharya (Ch. Su. 11/37). Acharya* has described the *Ayoga* (deficient), *Atiyoga* (excessive) and *Mithyayoga* (perverted) of each *Indriyartha* separately.

These consequences of *Ati, Ayoga* and *Mithyoga* of speech, body and mind have also been described by *Charakacharya (Ch. Su. 11/39).*

Since sense organs both *Jnanendriya* as well as the *Karmendriya* are important factors in perception, cognition and behavioral outputs given by an individual, the *Asatmendriyartha Samyoga* will affect their normal functioning. Most of the consequences described in the text are related to the higher intellectual functions. These functions are hampered in ADHD as well. Thus *Asatmendriyartha Samyoga* can be considered among one of the *Nidana* of ADHD.

**(c) *Ahara:***

*Ahara* is said to be *'Pranaha Pranabhritam*' an important factor on which life depends. Thus it is also an important determinant of adequate functioning of both the body and the mind.

*Mana* and *Indriya* are *Panchabhautika* and derives their nutrition through the *Panchabhautika ahara* taken by the individual.

Similar reference is also found the *Upanishadas* that the finest portion of the food provides nourishment to the mind and that mind is a product of the food we take. Therefore *Mana* is said to be "*Annamaya*". *Prajna, Medha, Tushti* etc. are said to dependent on food.[30]

Thus the ingestion of unwholesome diet, predominant in *Rajasika* and *Tamasika* properties will have similar effects on the mind, leading to abnormal *Prajna, Smriti* etc. The process of knowledge perception will be affected, thus the final resultant will be an abnormally functioning mind.

Some specific *Nidana* mentioned with respect to their effect on *Manas* are as follows:

- Excessive ingestion of any one particular rasa leads to various disorders some of which are at the level of psyche.[31]
- *Lavana rasa* -hindrance to the functioning of *Indriyas* and causes *Moha*
- *Katu rasa –Moha, Tama* and *Bhrama.*
- *Tikta rasa –Moha, Bhrama.*

Therefore the consumption of any one rasa in excessive amounts has been condemned by the classics.

Thus it is an important determinant of not only physical but also psychological well being of an individual.

Modern researchers have now established the relationship between diet and ADHD as diet modification have been seen to give better results in controlling the hyperactivity.

***(d) Nidra***

*Sukha, Dukha, Jnana, Ajnana* are said to be dependent on *Nidra* [32]

Disturbances and abnormalities of sleep can thus be a reason for abnormalities of higher intellectual functions, sleep abnormalities is one of the known contributory factor of ADHD.

**(e) *Manasika***

*Sushrutacharya* has explained the *Manasika Rogas* as being caused by the psychic and emotional *doshas* like *Karma, Krodha, Bhaya, Harsha, Vishada, Irshya, Manodainya, Iccha, Dvesha* etc. *(Su. Su. 1/33).* In modern parlance as well, emotional disturbances due to family discord, broken homes etc. are one of the causes of ADHD.

These lead to imbalance of the ratios of *Sattva guna* to *Tama* and *Raja* leading to diseases.

***AGANTUJA NIDANA***

They are caused by *kshata, Bhanga, Prahaara*, etc; according to the mode of affliction. They are of two types-

- *Saririka* and
- *Manasika*

***Saririka:***

***Shirobhighata***

*Shiras* is one of the vital parts of the body and is the seat of all the sense organs. *Shirobhighata* has been considered as a causative factor for *Shiroroga*. Any

injury to *Shiras* can directly lead to injury to the *Indriya* as they are situated in it. different types of *Abhighaatas* are told as causative factors for mental illness e.g. injury to *Seemanta marma* may cause *Unmaada*.[33] Different types of prenatal and post natal brain insults and obstetric trauma have been known to cause ADHD.

***Visha***

It is also an exogenous factor in illness causation, which is very much related to mental illness and exposure to *Visha* and *Upavisha*, *Viruddha bhojana*, *Gara visha* are becoming *Nidaanas* due to the properties of the *Visha*. In the case of ADHD toxic exposure of the pregnant mother and the child to Lead and like environmental pollutants are described as the causative factors. Postulations regarding food additives, colorings, preservatives are also seen in the literature.

***Bhutaveshaja Nidana:***

It is considered as one of the causes of diseases. Unexplained, sudden occurrence of disease without any obvious causative factor was attributed to *Bhutavesha*. This includes infectious diseases like encephalitis which are considered as the etiological factor for ADHD.

***Manasika:***

- Generally negative emotions like *Irshya, Soka, Bhaya, Krodha, Maana, Dvesha* are considered as exogenous causative factors for mental illness. [34]
- *Hina, Mithya* and *Ati yogas* of *Arthas* of *Manas* are responsible for afflicting *Manas* and *Buddhi*.[35]
- It is also told that children should not be threatened to make them calm from temper tantrums.

In case of ADHD, negative Psycho social environment like Deprivation, Abuse, Neglect, Poor Socio economic status are explained as etiological factors.

## *PURVARUPA* OF ADHD

The symptomatology of the disease may start very early in childhood but get clearly manifested only later by the structured life offered by the school. The modern researchers have described no such prodromal symptoms. But *Avyakta* or *Alpa lakshanas* can be considered as the *Purvarupas.*

## *LAKSHANAS* OF ADHD

Attention deficit / hyperactivity disorder is characterized by 3 core symptoms of –

- Inattention,
- Hyperactivity
- Impulsivity

**INATTENTION - *Dhee Dhriti Smriti vibhramsha*:**

*Dhriti* is the controlling factor of *Manas.* The basic nature of mind is mingling with its *Arthas* and stimulating the *Indriyas* but it is endowed with the karmas called *Indriyabhigraha* and *Swasya nigraha. Abhigraha* means to Catch, seize or assault i.e. *Manas* is having power over the *Indriyas* to direct them towards the particular *Arthas.* At the same time it is having *Swasya nigraha* or Self control or restraint.

So when the mind functions normally it enable the flow of knowledge from a particular *Indriya,* by cutting down the channels of sensory input from other unwanted stimuli which is called selective attention.

If the *Manas is* shifting its presence from one *Indriya* to another, which irrelevant or unwanted, a normal *Dhriti* controls the manas from indulging in such *Indriyarthas.* Thus *Dhriti* helps to sustain attention and concentration.

In ADHD due to this *Dhriti bhramsha, Manas* is unable to sustain focus on particular *Indriyartha* and it is frequently shifting from one *Indriya* to another *Indriya* attending unwanted or irrelevant stimuli. Analyzing these factors we can see that attention is a combined effect of *Indriyabhigraha* and *Swasya nigraha*, which are the karma of *Manas* further controlled by *Dhriti.*

*Dhee*- that is the understanding and discriminating capability between beneficial and non-beneficial and *Smriti* that is recollection, both work in association with the *Dhriti* and lead to normal process of *Jnanotpatti*. Abnormalities of *Dhee*, *Dhriti* and *Smriti* – i.e. *Vibhramsha* will lead to abnormalities of *Prajna* - the volitional power i.e. *Prajnaparadha*.[36]

Due to this the *Manas* loses its capacity of concentration, attention and learning.

***Anavasthita chittatvam:***

In *Nanatmaja vikaaras* of *Vata* explained by *Charaka*, *Anavasthita chittatvam* is one of the condition among eighty.[37] *Vata* is having the *gunas* like *Chalatvam* and *Anavasthitvam.* Due to these properties, in *Vata vriddhi, Mano vibhrama* takes place resulting in losing the control over *Indriyas* in sustaining the perception for a specified time to get a cognizable knowledge.

***Aratih:***

According to *Dalhana*,

*"Aratih na kutrachit avasthiti chittasya"* [38]

That means unstable mind or Restless mind (Inattention).

According to *Vachaspati*,

*"Kasmin api vishaye na chiravasthiti"*

That means mind is unable to concentrate on object for a specified time to get a cognizable knowledge (Inattention).

According to *Arunadatta*,

*"Sthaanaasana sayanadishu anavasthitatvam chetasah"* [39]

That means the person is unable to sit, stand or sleep in a particular place for some time. The person looks like restless and unable to concentrate on anything (Inattention).

This condition may manifest in,

- *Aagantuja unmada poorvaroopa*
- *Unmada arishta*
- *Pittavrita samana vayu kopa*
- *Samanavrita prana vayu kopa*

**HYPERACTIVITY**

*Hyper* is a prefix, which means "more than usual or excessive". Activity deals with "motion or movement". Hyperactivity includes behavior described as restless and fidgety, especially if this is an everyday, every time phenomenon. Activity is denoted by the term *"Cheshta"* in *Ayurveda.*

***Cheshta:***

According to *Arunadatta, Cheshta* is of three types, [40] *Vaak cheshta, Saririka cheshta, Manasika cheshta.*

So the above commentaries reveal that the actions or gestures or behaviors by body, mind and speech may be considered as *Cheshta.*

***Chapala cheshta (Chala cheshta )***

*"Chalam asthiram"* [41] *"Lolam chapalam"* [42]

This means unsteady activities.

***Cheshta vibhrama:***

*"Cheshta vibhramat anuchita cheshta bhavati"*[43]

This means improper activities.

***Vata prakopa:***

*Gati* and *Chalatva* are the properties of *Vata* and it is the originator and executor of bio-motor functions through the *Cheshtavaha srotas,* which is mainly done by Vyana.[44] So when it becomes vitiated *Chalatva* increases and it causes excessive *Manocheshta,* resulting in *Kayacheshta* and *Vaakcheshta* and causes dysfunction all over the body. The increased *Cheshta* further vitiates *Vyana vata*.[45]

In the case of Hyperactivity in ADHD, it is partly due to the response to the sensory input from many sources through *Samjna Vaha Srotas*. Due to *Manovibhrama,* as *Manas* is an *Ubhayendriya,* its impairment results in indiscrimination of good and bad sensory stimuli *(Dhee bhramsa )* and response to all results in the *Atiyoga* of *Karmendriyas* manifested as excessive *Cheshta,* though it is purposeless or not goal directed. It is coupled by the impairment of *Dhriti,* which should prevent the undesirable acts. Thus the child squirms, fidgets, find difficulty to remain seated or engage in quiet activities and plays, talks excessively and seem as if driven by a motor depicting *Chestāvibhrama.*

This can also be expressed by *"Atana sheelata"* and *"Bahu bhashitvam"* of Rajas.

**IMPULSIVITY**

Impulsivity is a sudden action that is under taken without careful thought. Some related conditions in *Ayurveda* are,

***Austukyam:***

According to *Hemadri, "Avicharyah karya pravritti"* [46]

This means without thinking indulging in activities or excitement.

***Buddhi vibhrama:***

The normal function of Buddhi is decisive cognition of the *Indriyarthas* by the respective *Indriya buddhi* and specific direction accordingly for requisite motor function or *Cheshta,* either vocal or physical.

In the case of *Buddhi vibhrama* the person get lost himself in the *Vishayaas* and take sudden decisions without considering the consequences and situations i.e., a proper decisive cognition doesn't occur in response to a sensory stimuli and results in impulsive actions or thoughts. It is associated with the impairment of *Dhriti* that should control particular *Karmendriya* from performing the impulsive act.

**TABLE-6**

| Characters of ADHD | Characters of MANAS |
|---|---|
| 1.INATTENTION | |
| • Making careless mistakes in school activities.<br>• Finds difficulty in organizing tasks and activities. | *Dhee Vibramsha* |
| • Difficulty sustaining attention in tasks or play.<br>• Easily distracted. | *Dhriti Vibramsha* |
| • Looses the things often.<br>• Forgets in daily activities | *Smriti Vibramsha* |
| 2.HYPERACTIVITY | |
| • Fidgets with hands or feet or squirms in chair.<br>• Difficulty to remain seated in classroom or in other places where it is needed. | *Chapala Chestam* |
| • Runs or climbs excessively.<br>• Acts as if driven by a motor or in hurry. | *Chala Asthiram* |
| • Has difficulty in playing or engaging activities quietly.<br>• Talks excessively. | *Atana Sheelata, Bahubhashitvam* |
| 3.IMPULSIVITY | |
| • Blurts out answers before questions have been completed.<br>• Interrupts or intrudes upon others. | *Austukyam- Avicharyah karya pravritti* |

*Smriti vibhramsha* leads to inability of the child to learn from past experiences, thus the child will behave impulsively. The Manoarthas are also deranged leading to inappropriate thought processes and inappropriate decisions, which will also lead to impulsive behavior. Thus the child blurts out answers at wrong

places, unable to wait for turn, often intrude on others, becomes aggressive and often engages in dangerous activities.

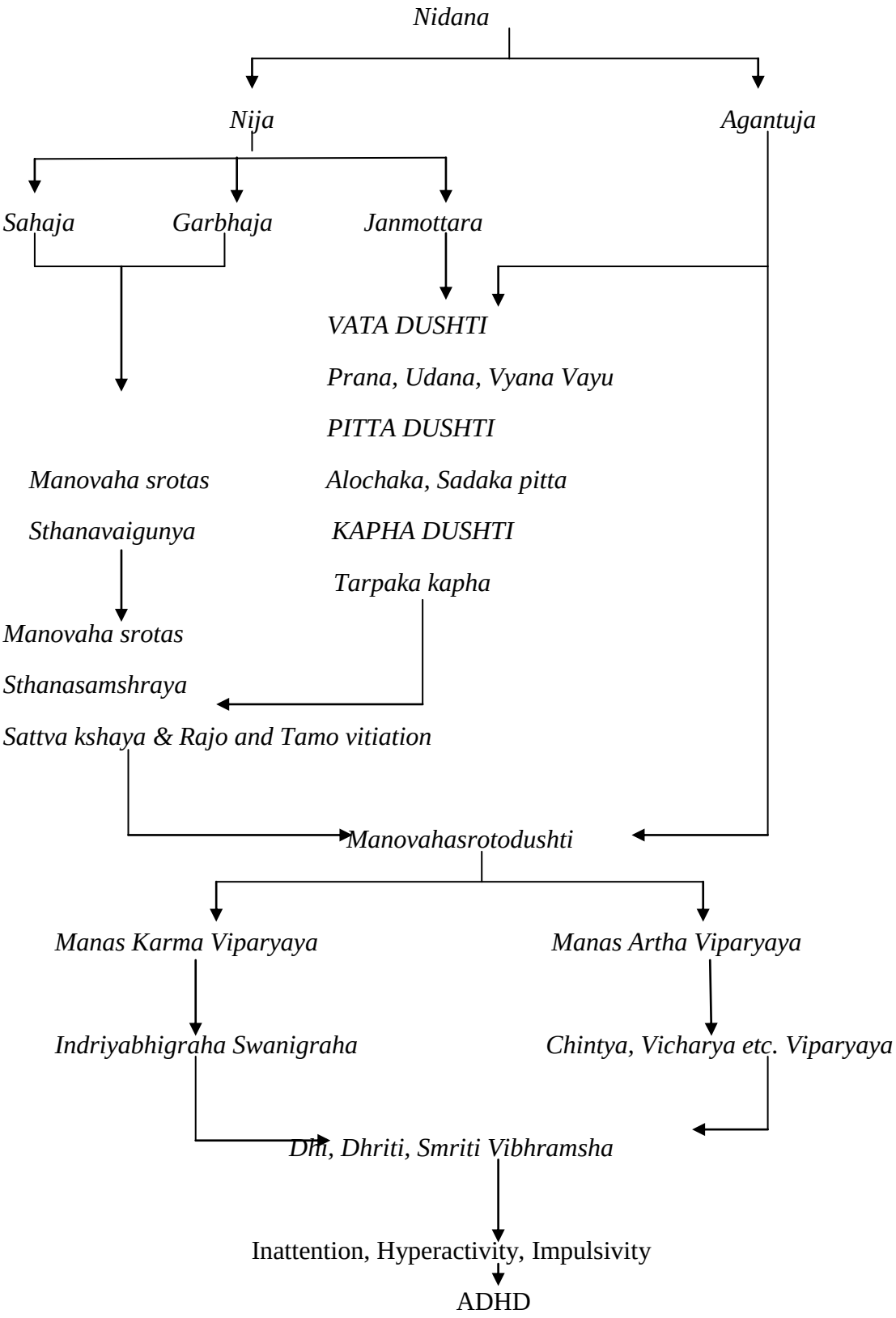
Thus the core symptoms of ADHD – Inattention, Hyperactivity and Impulsivity are compared with the clinical features of derangement of *Manas* and its functions.

***SAMPRAPTI***

The *Samprapti* explains the mode of development of the disease due to the effect of *nidaana* and further differentiation. This is the most important part in defining a new disease in *Ayurvedic* methodology. The *Samprapti Ghataka* of ADHD can be categorized as follows:

| | | |
|---|---|---|
| *Dosha – Sharirika* | - | *Vata – Prana, Udana, Vyana* |
| | | *Pitta – Buddhi vaisheshika Alcohaka, Sadhaka* |
| | | *Kapha – Tarpaka –* |
| *Manasika* | - | *Rajas* and *Tamas* |
| *Dushya* | - | *Rasa, Majja* |
| *Srotas* | - | *Manovaha Srotas* |
| *Dushti* | - | *Atipravritti* |
| *Agni* | - | *Vishama* |
| *Udbhavasthana* | - | *Mastishka, Hridaya* |
| *Vyaktisthana* | - | *Sarva Sharira* |
| *Rogamarga* | - | *Madhyama* |

**CHART-2 SCHEMATIC REPRESENTATION OF SAMPRPATI**



The etiological factors have been reviewed in detail previously. The *Nija Nidana* of ADHD mainly the *Sahaja* and *Garbhaja Nidana* lead to genetical and congenital *Sthanavaigunya* at the site of *Manovahasrotas*. As these factors act at the level of the *Manas* e.g. Inheritance of *Manas Prakriti* and *Sattva* of the parents or antenatal factors like *Dauhrida Vimana,* these children are prone to the *Manas vyadhi* since birth. These factors also affect the developing *Jnanendriya* and *Karmendriya* of the child making them more susceptible to abnormalities of their functions.

The *Janmottara Nidana* primarily causes the vitiation of *Vata Dosha*. Among the five functional types of *Vata dosha, Prana, Udana, Vyana* are vitiated leading to abnormalities of their functions. The etiological factors also cause *Vriddhi* of *Pittadosha* and vitiation of functions of *Buddhi vaisheshika Alochaka* and *Sadhaka Pitta*.

*Acharya Bhela* has described the 2 types of *Alochaka Pitta* one of which is the *Buddhivaisheshika Alochaka Pitta*. This is related to the higher intellectual functions. The *Ahara, Vihara, Asatmendriyartha samyoga, Nidra* etc., cause the derangement in the functions of *Buddhivaisheshika Alochaka Pitta.*

These factors also cause the abnormalities of functions of *Sadhaka Pitta*. Vitiated *Sadhak Pitta* can cause *Bhaya, Krodha, Harsha, Moha* and inadequate functioning of the Indriya.[47] *Sushrutacharya* has enumerated *Medhakrita Pitta* among the five types of *Pittadosha.* This functional variant of *Pitta Dosha* will be deranged by the *Nidana Sevana.*

Vitiation of *Kapha Do*sha mainly that of *Tarpaka Kapha* is seen. *Tarpaka Kapha* is responsible for indriyatarpana.[48] Vitiation of *Tarpaka Kapha* will lead to abnormalities of the functioning of various *Indriyas.*

The *Agantuja Nidana* exert their influence in two ways, they can cause the *Doshadushti* primarily then lead to *Manovahasrotodushti,* or they can directly affect the *Manovaha Srotas* e.g. *Bhutavesha* and *Shirobhighata* etc

Due to the already existing *Sthanavaigunya* in the *Manovahasrotas*, the vitiated *doshas* causes afflict this site (*Sthanasamshraya*). This leads to decrease in the *Sattva guna* and vitiation of *Tamo Dosha* and *Rajodosha* of *Manas*.[49, 50]

There is vitiation of the *Manovahasrotas* leading to *Manovahasrotodushti*. *Manovahasrotodushti* causes derangement of functions of the *Manas (Manas Karma*) and objects of the *Manas (Mano artha).*

The derangement of the functions of *Manas* specifically in that of *Indriyabhigraha* and *Swanigraha* leads to the *Vibhramsha* of the volitional power-*Prajna* and its factors i.e. *Dhee vibhramsha*, *Dhriti vibhramsha* and *Smriti vibharamsha*. The *Manoartha*s, which are vital for the volitional power of *Manas*, are also deranged. These together lead to manifestation of the diseases ADHD with the core symptoms of Inattention, Hyperactivity and Impulsivity.

***SADHYASADHYATA***

Milder forms of the disease with few clinical symptomatology and without any co-morbidity generally resolve by adolescence and can be considered as *Sukhasadhya.*[51]

Those with associated co-morbidities like conduct disorder, learning disability etc. and are moderately severe in their clinical presentation and in the early stages of the disease are *Kricchrasadhya.*[52]

The patients with all the symptoms of ADHD with co-morbidities and having a genetic predisposition are *Yapya*.[53]

***CHIKITSASUTRA***

The management of the disease ADHD can be given under two headings.

(1) Prophylactic measures

(2) Specific measures

**(1) Prophylactic measures:**

Ayurvedic science has laid lot of emphasis on the avoidance of the causative factors of disease and has described it as the first line of treatment.

Since the ADHD has a strong genetic predisposition and antenatal etiopathogenesis, the following line of treatment is very important.

**Preconception measures –**

It begins from the period of preconception like following the detailed measures of preparation of the couple for conception.

**Antenatal management – *Garbini paricharya***

The pregnant woman has to obey various norms of health so as to keep herself and the fetus healthy. Every physiological and psychological variation in the mother exerts its influence on the growing fetus.

*Pumsavana Samskara*, which is to be performed during the early stage of the pregnancy, not only has significance in selection of sex of the child but also ensures a healthy progeny.

**Postnatal management:**

The perinatal insults to CNS have known to lead to ADHD. Thus the *Jatakarmas* mentioned in the *Paricharya* of *Navajata* should be followed. *Bala Paricharya*, use of various *Prasha* and the *Medhya Rasayanas* mentioned in the classics should be done so as to prevent the disease ADHD.

**(2) Specific Measures:**

Since the disease ADHD is being considered as a type of *Unmada Vyadhi (Vata pittothara sannipatha), Unmada* treatment principle i.e, *Sodhana* and *Samana Snehana* should be given importance.

- *Chikitsa* alleviating *Tridoshas* particularly *Vata* and *Pittadosha,* and having effects on the *Manas* should be preferred.

- *Bahya Prayogas* like *Murdha Taila,* and *Sarvanga abhyanga* should be done to pacify the *Vata Dosha.*

- *Sneha virechana* brings about the elimination of vitiated *doshas* particular for the disease.

- *Nasya*: Elimination of vitiated *doshas* from siras by means of *Virechana nasya,* followed by *Samana nasya. Nasya* can be used effectively due to its direct effect on the *Indriyas*

- The use of *Medhya rasayanas* and *sneha dravyas* especially *ghrita.*

***Sattvavajaya chikitsa***

It is the major treatment protocol for the psychological disorder.

Counseling of the parents, family members, teachers and child itself is of great help. The modern medicine also makes use of cognitive behavioral therapy in combination with the pharmacotherapy of ADHD.

***Chikitsa* with *Yoga***

Use of various *Yogasanas, Pranayama*, and *Mudra* can be done to improve the controlling power of the mind.

***PATHYAPATHYA***

Following a regime of diet and the practice of good conduct and behavior are important part of the management of the disease. *Pathya* has to be followed even before the treatment starts. From the purity of food born the purity of mind, which indicates the role of food in providing mental health and intellectual life. *Pathya* that has to be followed in whom ADHD can be incorporated is described here:

***Pathya Ahara* and *Vihara :***

Rice, Wheat Green gram Grapes, Gooseberry, Guava, Jack fruit, Ripe mango, Ghee, Milk, Honey, Butter, Coconut, Sweet, Unctous, Easy to digest can be used.

Adequate sleep, Cleanliness, happiness, smoothening, courageous.

***Apathya Ahara* and *Vihara :***

Black gram, Papaya, Alcohol, Pungent, Bitter, Hot, Unclean, Unaccustomed, Improperly cooked and all types of *Mamsa ahara* should be avoided.

Suppression of urges such as sleep, hunger, thirst, traveling. Sorrow, anger, fear, jealousy.

# DRUG REVIEW

Mainly *Ayurveda* make use of *Yukti vyapasraya chikitsa*. For that it utilizes different drugs. *Acharya Charaka* in *suthrasthana*, gives the importance of *Yukthi* and knowledge of drugs. He says that the art of prescription depends on knowledge of dosage and time, and on this art in turn depends success, hence the skillful physician stands ever superior to those possessing merely a theoretical knowledge of drugs.

The term *Dravya* is derived as *"Dru-Gathou iti dhatu" Druyate, Gamyate, jnayate rasadibhi iti Dravya* i.e. the one which can be known by *Rasa, Guna, Veerya* etc. is known as *Dravya. Dravya* has been included under the *Chatushpadas* of *Chikitsa* (four fold basic factors of therapy), without which treatment never comes to success.

The term "DRUG" is derived from the Greek word "DROGUE" which means –any substance that when taken into the living organism may modify one or more of its functions. W.H.O defines drug as any substance or product that used or intended to be used to modify or explore physiological systems or pathological states for the benefit of the recipient.

In the present study medicated *Takra* (processed with *Churnas* of *Vacha, Brahmi, Aswagandha, Jatamansi*) was used for Dhara.

The pharmacological as well as pharmcodynamic properties and therapeutic uses of each ingredient present in the *Takradhara Yoga (Vacha, Brahmi, Jatamansi, Aswagandha)* are as follows:-

***Vacha***[1, 2, 3]

**Figure no.1**

***Sanskrit name:***

*Vacha*

***Botanical name:***

Acorus calamus

***Family:***

Aracea

***Synonyms:***

*Ugragandhā, Ugrā, Ṣaḍgranthā, gōlōmī, śataparvikā, kṣudrapatrī, maṅgalyā, jaṭilōgra, śataparvā, parāruṇā, dhīraraktā, yōgavatī, karṣaṇī, śubhā*

***Chemical Constituents:***[4]

Volatile Oil (principal constituents of the Volatile oil are Asamyl alcohol, Eugenol and Asarone), also contains a bitter principle Acorin (Glucoside), Starch and Tannin.

A new flavone has been isolated from the rhizonies.

***TABLE-8 Properties and action:*** [5, 6, 7, 8]

| | |
|---|---|
| *Rasa* | *Kaṭu, Tikta* |
| *Guṇa* | *Laghu, Tīkṣṇa* |
| *Vīrya* | *Uṣṇa* |
| *Vipāka* | *Kaṭu* |
| *Karma* | *Vātahara, Kaphahara, Mala Mūtraviśodhanī, Dīpanī, Kaṇṭhya, Krimihara, Vāmaka, Medhya* |

वचोग्रगन्धा कटुका तिक्तोष्णा वान्तिवह्निकृत्।

विबन्धाध्मानशूलघ्नी शकृन्मूत्रविशोधिनी॥

अपस्मारकफोन्मांदभूतजन्त्वनिलान्हरेत्॥१०३॥ (भा. प्र. नि. हरीतक्यदिवर्ग १०२-१०३)

वचा तीक्ष्णा कटूष्णा च कफामग्रन्थिशोफनुत् ।

वातज्वरातिसारघ्नी वान्तिकृन्माद□□□नुत् ॥ (रा. नि. पिप्पल्यदिवर्ग ५२)

वचा तिक्ता कटुः पाके कटुरुष्णामपाचनी।

दीपनी वामनी मेध्या जीवनी वाक्स्वरप्रदा॥१२१६॥

हन्त्युन्मादमपस्मारं रक्षोजन्तुकफानिलान्।

शूलं विबन्धमाध्मानं शकृन्मूत्रविशोधनी॥ (कै. नि. ओषधिवर्ग १२१६-१२१७)

***Therapeutic uses:*** [9]

*Apasmāra, Unmāda, Vibandha, Ādhmāna, Śūla, Karṇa Srāva, Kāsa, Śvāsa, Smṛti daurbalya*

***Pharmacological actions:*** [10, 11]

Alcoholic extract of the plant causes sedative and analgesic effects, moderate depression in blood pressure and respiration, rhizome extract and essential oil effective against houseflies. Other pharmacological activities are hypothermic, hypotensive, spasmolytic, CNS depressant, anticonvulsant, carcinogenic, antimicrobial, antielmenthic, insecticidal, antibacterial and sedative-tranquillizing.

***Parts used:***

Rhizome

***Dose:***

60 -120 mg of the drug in powder form.

1- 2 gm of the drug in powder form for inducing vomiting.

***Important formulations:***

*Vacādi Taila, Vacā Laśunādi Taila, Sārasvata Cūrṇa, Sārasvatāriṣṭa, Mānasamitra Vaṭaka, Candraprabhā Vaṭī, Khadirādi Vaṭī, Hiṅguvacādi Cūrṇa*

***Pharmacological studies:*** [12]

1. Nootropic Activity: The Neuropsycho-pharmacological effect of a polyherbal formulation Bramhi Ghrita (BG) on learning and memory processes in rats by elevated plus maze, and in mice by Morris water maze model. BG contains Acorus calamus. Its effect (30, 50 and 100 mg/kg, p.o.) was tested on learning

and memory processes. BG may act as a memory enhancer formulation and may also be useful as a supportive adjuvant in the treatment of impaired memory functions.

2. CNS Activity: The methanol and acetone extract of the plant possess certain psychoactive substances that are found to be depressant in nature. The extract produced alterations in the general behavioral pattern and does not induce any disturbances in the motor co-ordination. The methanol and acetone extract of the leaves of the plant posses CNS depressant activity which can be further utilized for its anticonvulsant research .Most studies proved that the roots and rhizomes of the plant posses the most CNS depressant activities.

***Research articles:***

1. Sala et al. (1993) list the plant with traditional uses as an intellect-promoting agent against depression, mental disorders and general debility. Acorus calamus is also combined with Polygala root to help maintain mental and intellectual health of the elderly (Hou and Jin, 2005). When powdered, it can be of avail for depressed psychosis and dementia. Further indications include the loss of consciousness, confusion of the mind, forgetfulness, anorexia and epilepsy and as a traditional Ayurvedic medicine to treat memory loss (Howes and Houghton, 2003). [13]

2. Acorus calamus is registered in the Pakistani Materia Medica where both the roots and rhizomes are used for nervous diseases and disorders, whereas the rhizome is especially indicated in cases of neurological symptoms of the brain (Said and Ahmad, 1986).[14]

3. Acorus calamus extract is also used in traditional Chinese prescription and its beneficial effects on memory disorder and learning performance, by decreasing brain lipid peroxide content have been reported.[15]

***BRAHMI* :**[16, 17, 18]

**Figure no.2**

***Sanskrit name:***

*Brāhmī*

***Botanical name:***

*Bacopa monnieri*

***Family:***

Scrophulariaceae

***Synonyms:***

*kapōtavaṅkā*, *sōmavallī*, *sarasvatī*, *maṇḍūkaparṇī*, *māṇḍūkī*, *tvāṣṭrī*, *divyā*, *mahauṣadhī, saumyā*, *vinirdiṣṭā*, *divyatējā*, *tvāṣṭā, saiva, brahmasuvarcalā.*

***Chemical Constituents:*** [19]

Compounds isolated from B. monniera include two saponins-

Bacoside A and B, beturic acid, D-mannitol, stigmasterol, b-sitosterol and stigmasterol.

Alkaloid and brabmine were isolated from the alcohol extract. Plant also yielded betulinic acid, ‘-sitosterol, stigmasterol, mannitol, saponin-bacoside A (3-arabinopyrano-d-glycopyra- noside4O, 20-dihydroxy- 16-oxodammarene).

***TABLE-9 Properties and action:***[20,21,22,23]

| | |
|---|---|
| *Rasa* | *Tikta, Kaṣāya, Madhura* |
| *Guṇa* | *Laghu, Sara* |
| *Vīrya* | *Śīta* |
| *Vipāka* | *Madhura* |
| *Karma* | *Vātahara, Kaphahara, Rasāyana, Āyuṣya, Medhya, Matiprada, Svarya, Prajāsthāpana, Viṣahara, Mohahara* |

ब्राह्मी हिमासरा तिक्ता लघुर्मेध्या च शीतला।

कषाया मधुरा स्वादुपाकाऽऽयुष्या रसायनी॥२८०॥

स्वर्या स्मृतिप्रदा कुष्ठपाण्डुमेहास्रकासजित्।

विषशोथज्वरहरी तद्वन्मण्डूकपर्णिनी॥२८१॥ (भा. प्र. नि. गुडूच्यादिवर्ग २८०-२८१)

ब्राह्मी सौम्या रसे तिक्ता शोफपाण्डुज्वरापहा ।

दीपनी कुष्ठकण्डूघ्नी प्लीहवातबलासजित् ॥९०॥ (ध. नि. करवीरादिवर्ग ९०)

ब्राह्मी हिमा कषाया च तिक्ता वातास्रपित्तजित् ।

बुद्धिं प्रज्ञां च मेधां च कुर्यादायुष्यवर्धनी ॥ (रा. नि. पर्पटादिवर्ग ६६)

***Therapeutic uses:***[24]

Kuṣṭha, Jvara, Śopha, Pāṇḍu, Prameha, Mānasavikāra

***Pharmacological action:*** [25, 26]

- Tranquillizer, smooth musculature relaxant, antispasmodic, anticancer and antirheumatic, analgesic. Alcoholic extract increased the learning performance of rats and activity is attributed to saponin mixture consisting of bacosides A, B and other saponins. Hersaponin exhibited sedative action in mice.
- *Brahmi* shows better acquisition, improved retention and delayed extinction, improved performance in various learning situations.

- Singh et. al. (1979) had already reported an increase in acetylcholine concentration in the frontal cortex of normal rats given 40 mg/kg of Bacopa extract orally once daily for 15 days. The acetylcholine level was reduced in other parts of the brain in their study.

- In other words, the effects of *Bacopa* may be able to influence the psychoneurological functions associated with intellectual behavior.

***Part used:***

Whole plant

- Leaves of *Brahmi* with sugar in children with speech problem.

- Whole plant *Brahmi* is considered a nootropic agent which is the term given to a drug that improves mental functions such as cognition, memory, intelligence, motivation, attention, and concentration.

**Dose:**

1-3 g in powder form.

**Important formulations:**

*Sārasvatāriṣṭa, Brāhmī Ghṛta, Ratnagiri Rasa, Brāhmī Vaṭī, Sārasvata Cūrṇa, Smṛtisāgara Rasa*

**Pharmacological studies:**

**a**) The maximum improvement in the T-maze-learning in albino rats occurred following treatment with a whole plant extract of B. monniera for 24 days (Personal communication with Bala Manyam and H.K. Sing & B.N. Dhawan et al, 1997).

**b)** The data of study on an aqueous suspension of alcoholic extract of B. monniera (40 mg/kg. p.o.) for three or more days in rats suggest that B. monniera can improve the performance of rats in various learning situations.

**c)** The effect of B. monniera is shown to be due to the saponin bacosides. Saponin free fractions were inactive. Pilot studies showed that standardized extract containing

60 - 70% saponins was better than individual bacosides A or B, or a mixture of both of them. For this reason, crude extract was chosen instead of individual fractions by the authors. The crude extract produced a dose dependent positive effect in test involving brightness discrimination (Y-Maze), acute conditional flight reaction (Cook's Pole Climbing Test), continuous avoidance (Sidman's Avoidance Test) and conditional taste aversion. The tests utilized visual, auditory and taste cues. The amnestic activity of electric shock, immobilization and scopolamine was also effectively antagonized.

**d)** It improves the motor learning process in rats and is tranquilizer (weaker than chlorpromazine) (Ganguli et al). Depletes brain monoamines especially noradrenaline and serotonin (Malhotra et al, 1963).

**e)** Baccopa because of its bacosides, significantly improves learning and memory and even other higher C.N.S. functions (Dhavan et al, 1998).

f) In 1933, when the Central Drug Research of India (CDRI) began extensive research of their rich herbal treasures to source active ingredients for modern therapeutic uses, they started clinical trials with *Brahmi* on human volunteers.

**Clinical studies:**

1. *Brahmi* is tonifying herb that protects and nourishes the nerves, thus it supports normal nervous system activity. 90 day treatment with *Brahmi* has shown to improve working memory and accuracy of special memory in children with ADHD.[60]

2. Another study demonstrated that a 5 and 12 week course of *Brahmi* also improved the function of Auditory Verbal Learning.[61]

3. *Brahmi* also proved helpful in improving attentiveness among children with ADHD.[62] When given in combination of Ginkgo, *Brahmi* also helped to improve planning and problem solving, information processing speed, motor responsiveness and decision making.[63] These improvements are indication of enhanced function of the brain due to the effect of *Brahmi.*

***Research Articles:***

1. A randomized controlled trial investigating the effects of a special extract of Bacopamonnieri (CDRI08) on hyperactivity and inattention in male children and adolescents : BACHI study protocol (ANZCTRN 12612000827831). James D. Kean, Jordy Koufman, Hemant Singh, Andrew Zangara, Con stough. Nutrients, 2015 Dec; 7(12): 9931-9945. Published online 2015 Dec 2. Doi: 10.3390/nu 7125507.

2. Efficacy of standardized extract of Bacopamonnieri( Bacognize) on cognitive function of medical students. A six week; Randomized placebo – controlled trial. Navneet kumar, L.G. Abichandani, Vijay Thawani K.J. Gharpuve, M.U.R. Naidu, G. Venkat Ramana doi: 10.1155/2016/4103423. PMCID: PMC5075615.

***ASHWAGANDHA :*** [27,28,29]

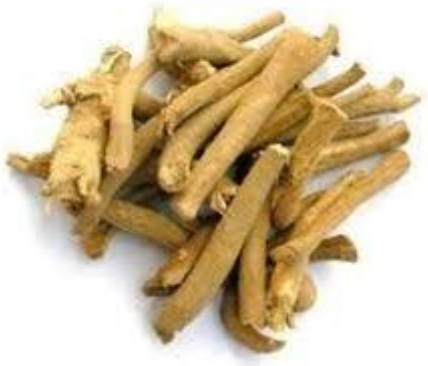


**Figure no. 3**

***Sanskrit name:***

*Ashwagandha*

***Botanical name:***

*Withania somnifera*

***Family:***

Solanaceae

***Synonyms:***

All the synonyms of the *vāji* if suffixed with *gandhā* will give the synonyms of *Ashwagandhā, aśvagandhā, hayāhvayā, varāhakarṇī, varadā, baladā, kuṣṭhagandhinī, vājigandhā, kambukāṣṭhā, varāhikā, turagī, vanajā, vājinī, hayī, puṣṭidā, puṇyā, hayagandhā, pīvarā, palāśaparṇī, vātaghnī, śyāmalā, kāmarūpiṇī, kālapriyakarī, balyā, gandhapatrī, hayapriyā, varāhapatrī, kañcukā, aśvāvarōhaka and vājīkarī*

***Chemical Constituents:*** [30]

In this drug, a bitter alkaloid "Somniferin" having hypnotic property and other Alkaloids and withanolides. like cuseohygrine, anahygrine, tropine, pseudotropine and anaferine, resin, fat and coloring matters, a reducing sugar phytosterol, puratnol, mixture of saturated and unsaturated acids. Ashwagandhine, Ashwagandhanine, Withaferin-A and a crystalline compound are mainly studied chemicals. Recently a new alkaloid visamine (Trutnova G. A., 1990) was also isolated.

***TABLE-10 Properties and Action:*** [31,32,33,34]

| | |
|---|---|
| *Rasa* | *Tikta, Kaṣāya* |
| *Guṇa* | *Laghu* |
| *Vīrya* | *Uṣṇa* |
| *Vipāka* | *Madhura* |
| *Karma* | *Vātakaphāpaha, Balya, Rasāyana, Vājīkaraṇa* |

अश्वगन्धा कटूष्णा स्यात्तिक्ता च मदगन्धिका ।

बल्या वातहरा हन्ति कासश्वासक्षयव्रणान् ॥ (४/११२) (रा. नि. शताह्वादिवर्गः)

अश्वगन्धाऽनिलश्लेष्मश्वित्रशोथक्षयापहा।

बल्या रसायनी तिक्ता कषायोष्णाऽतिशुक्रला॥१९०॥ (भा. प्र. गुडूच्यादि वर्गः)

अश्वगन्धा कषायोष्णा तिक्ता वातकफापहा ।

विषव्रणक्षयान् हन्ति कान्तिवीर्यबलप्रदा ॥२६३॥ (ध. नि. गुडूच्यादिवर्गः)

***Therapeutic Uses -***

*Kṣaya, Daurbalya, Vātaroga, Śotha, Klaibya.*

***Pharmacological actions:*** [35, 36]

Hypotensive, bradycardiac and respiratory stimulant, antibacterial, hypothermic, immunosuppressive, immunostimulatory, immunomodulatory, adaptogenic, antitumour, radiosensitising, antistress, anticonvulsant, psychotropic, CNS depressant, antioxidant, antiinflammatory, antispasmodic, analgesic, antipyretic, antiviral, antiarthritic, sedative, cardiotropic, cardioprotective, anticoagulant, antiageing, cytoprotective.

***Parts used:*** Root

***Dose :***

3-6 g of the drug in powder form

***Important Formulations:***

*Aśvagandhādyariṣṭa, Aśvagandhādi Lehya, Balāśvagandhalākṣādi Taila.*

***Pharmacological studies:*** [37, 38]

a) It is used as nervine tonic, as a sedative in the treatment of insanity, epilepsy and in certain forms of Hypertension. It has also been mentioned useful as abortifacient, amoebicide, anodyne, bactericide, diuretic and spasmolytic etc. Experimental data prominently label this plant as antistress, anti-inflammatory, anti-tumor, antibiotic, anticonvulsant, tranquilizer, immunopotentiating and C.N.S. depressant agent. The neuropharmacological activity was attributed to acetone soluble fraction of total alkaloids. Bio-chemically, whole brain acetylcholine and catecholamine levels were depleted, but produced an increase in the serotonin and histamine levels (Bhattacharya et al) [Indian Journal Pharmacology 1989, 22(1), 33].

b) Its root is known to possess C.N.S. department properties. Punjab University, Chandigarh and University of Texas health Sciences Center). Some of its C.N.S. effects include anti-stress, anti-anxiety and C.N.S. inhibitory properties, a profile

closely linked to the inhibitory putative neurotransmitter, r-amino butyric acid (GABA) or the anxiolytics benzodiazepines in recent years, the pharmacology of GABA benzodizepine receptor ligands has been extensively worked out (I.D. Vol. 30 No-7 July, 1993).

c) Dopamine, acetylcholine, benzodiazepine receptor population increase in stress was significantly ($p<0.01$) prevented by W. Somnifera. It also reduced brain succinate dehydrogenase enzyme (S.D.H.) increased due to stress. (C.C.R.A.S. study, 1987).

d) Malaviya et al, 1979 have established experimentally a psychotropic effect of Ashwagandha. According to him it includes a depletion of acetylcholine and catecholamine in the brain of rats. He has shown significant barbiturate hypnosis potentiation effect of this drug experimentally.

e) Sing et al, 1984 have extensively studied anti-stress activity of W. somnifera and found that it may be due to a state of non-specifically increased resistance (S.N.I.R.) during stress.

f) Ashwagandha is an important anti-stress medicine, which has similar activity to GABA, a relaxing neurotransmitter for the brain.[59] Active compounds in Ashwagandha bind to GABA receptors in the brain, helping to curb anxiety and uplift mood, inducing relaxation. Traditionally, the herb is used to treat patient with mood disturbances.

***Clinical Studies:***

a) The effect of *Ashwagandha* on anxiety neurosis was studied by Malaviya (1976). In his biochemical studies conducted in a series of patients found a statistically significant reduction of cortisol and catecholamine through urinary secretion. Cortisol and catecholamine are conventionally known as stress hormones and their turn over is notably increased during stressful conditions. Above findings were supported by Shukla et al (1982).

b) The drug possesses anti-fatigue and anti-stress activity. (Khandeparkar et al 1981; Singh et al 1977).

c) Chudasama and Singh (1986) studied *Rasayana* aspect of *Ashwagandha.* It showed relief of symptoms like *Agnimandya, Daurbalya*, exercise test, memory and weight gain in underweight patients, with significant increase in IGA, IGG and IGM levels suggesting its immunopotentiation.

***Research Articles:***

1. Effect of standardized aqueous extract of Withonia Somnifera on tests of cognitive and psychomotor performance in healthy human participants, Usharani pingali, Raveendranadh pilli, Nishal Fatima, doi: 10. 4103/ 0974-8490.122912. PMCID: PMC3897003.

***JATAMANSI :*** [39,40,41]

**Figure no. 4**

***Sanskrit name:***

*Jatāmāṁsī*

***Botanical name:***

Nardostachys jatamansi

***Family:***

Valerianaceae

***Synonyms:***

*Māṁsī, Jaṭā, Jaṭilā, Bhutajata, Tapasvini, Tamasi, Himsra*

***Chemical Constituents***: [42]

2% volatile oil containing an unidentified ester, an alcohol and two alkaloids (Bose et al, 1957). The rhizomes of N. jatamansiyielded jatamansic acid and Jatamamsone (Chaudhary et al, 1951), olieum, resin, sugar, starch, bitter extractive matter and gum. The active principle or drug is sedative, anodyne, antisposmodic, stimulant and mydriatic.

***TABLE-11 Properties and action:*** [43,44,45,46]

| | |
|---|---|
| *Rasa* | *Tikta, Kaṣāya* |
| *Guṇa* | *Laghu* |
| *Vīrya* | *Śīta* |
| *Vipāka* | *Kaṭu* |
| *Karma* | *Tridoṣagna, Medhya, Varṇya, Nidrājanana, Kuṣṭhaghna* |

मांसी तिक्ता कषाया च मेध्या कान्तिबलप्रदा॥

स्वाद्वी हिमा त्रिदोषास्रदाहवीसर्पकुष्ठनुत्॥ भा.प्र. कर्पूरादिवर्गः ८९॥

सुरभिस्तु जटामांसी कषाया कटुशीतला ।

कफहृद् भूतदाहघ्नी पित्तघ्नी मोदकान्तिकृत् ॥ (रा. नि. चन्दनादिवर्गः ९५)

***Therapeutic uses:*** [47, 48]

*Kuṣṭha, Dāha, Visarpa, Mānasaroga, Anidrā.*

***Parts used:***

Root

***Dose:***

2-3 g of the drug in powder form

5-10 g of the drug for decoction

***Important formulations:***

*Jaṭāmāṁsyarka. sarvousadha snanam, rakshoghna ghritam, mahaapaishachika ghritam amrutaadi tailam*

***Pharmacological Studies:***

**a)** In another study, aqueous, alcoholic volatile oil and alkaloid fraction of N. Jatamansi rhizomes and roots were studied for sedative and CNS effects. The alkaloid fraction showed a significant and sustained hypotensive action in dogs. The fraction also produced a marked relaxation of plain muscles and depression of CNS and a mild degree of relaxation of the skeletal muscle (Bose et al 1957).

**b)** Jatamnsone, the sesquiterpene from N. jatamansi was shown to exert tranquilizing activity in mice and monkeys, hypothermic activity in mice and anti-emetic in dogs (Arora et al 1962).

**c)** Various extracts of N. Jatamansi root showed both sedative actions in rats and revealed by physical inactivation and potentiation of phenobarbital sodium sleeping time in rats and the hypotensive activity in rats (Gupta et al, 1966).

**d)** The essential oil from the rhizomes had a depressant action on the CNS of guinea pigs and rats (Chopra et al, 1969).

**e)** A compound herbal preparation with N. Jatamansi, Acorus calamus (Vacha) and Valeriana wallichii (Tagara) as ingredients showed CNS depressant activity in rabbits and also inhibited the past isolation syndrome in mice (Moghe et al, 1981).

***Takra:*** [49]

***English Name***: Buttermilk

***Gana*** *: Amla Varga*

***Synonyms :*** *Takra, Mathita, Ghola, Udasvita*

***Properties :***

*Rasa : Amla, kshaya*

*Guna : Laghu, ruksha*

*Veerya: Ushna*

*Vipaka: Amla*

***Doshakarma*** *: Kapha-vata shamaka*

***Action & uses***: *Rochana, deepana, anulomana, grahi, krimighana, shothahara, mutrala, jvaraghna, vishaghna, srotoshodhaka, lekhana*

**Probable mode of action of drugs**

On examination of the pharmacodyanamic properties of the herbal drugs used in the formulation of *Ayurvedic* compound it shows that most of drugs have mainly *Tikta, Kashaya, Katu*, and *Madhur Rasa, Laghu, Snigdha* and *Sara Guna, Katu* and *Madhura Vipaka, Ushna Virya, Kapha-Vata Shamaka* properties, *Medhya* and *Rasayana Prabhava*.

***Rasa*:**

Analysis of *Rasa* present in the individual drugs reveals that the maximum number of drugs have *Tikta* and *Kashaya Rasa. Tikta Rasa*, being predominant in *Akasha Mahabhuta* and *Laghu Guna*, increases the *Sattva* part of *Mana. Kashaya Rasa* has predominance of *Vayu Mahabhuta* and *Laghu Guna*, which also increases the *Satavika* property of *Mana*[50]. *Vachana Nigrahanati* of *Kashaya Rasa* helps to decrease talkativeness. *Katu Rasa* dominates in *Agni Mahabhuta (Paka Karma)* and *Ruksha Guna*, which are responsible for *Indriyautejetaka* and *Sanjnanasa. Madhur Rasa* being predominant in *Parthiva Mahabhuta (Sthairakara Karma)*[50] *Snigdha*, and *Guru Guna*, increases the *Medhya* effect and *Indriyaprasadana. Brimhana* (by improving cellular nourishment) and *Sarvadhatuvardhaka* helps in proper development of all tissues in the body.

***Guna*:**

*Laghu* and *Sara Guna* are maximum in proportion. *Laghu Guna*, by virtue of having properties identical to that of *Sattva Guna*, increases the *Sattva* part of *Mana* that enhances the individual's *Utsaha* and *Sphurti* (stimulate pre &; postsynaptic receptors). By the *Prerana* (channelizing or motivation) property of *Sara Guna*, *Prerana Karma* of *Vata* becomes normalized and attention span is improved. *Snigdha Guna* increases the qualities of the *Tarpaka Kapha* and thereby nourishes the *Mana* and Indriyas. Brain tissue is exceptionally rich in lipid, especially in complex essential fatty lipids; *Snigdha Guna* is similar to these lipids and thus it can be assumed that these drugs, due to their *Snigdha Guna*, nourish the brain.

***Vipaka*:**

*Vipaka* of all ingredients present in the trial drug compound were *Katu* and *Madhur Vipaka*. The metabolism of our body, including the brain, is accelerated by *Katu Vipaka*, which helps in absorption of micro- as well macronutrients as per the body's needs and thus brings about a reduction of nutrient deficiencies. While on other hand *Madhur* is described as *Sarvadhatuvardhaka* including the brain tissue, *SadindriyapRasadaka* (nourish the *Mana* and *Indriyas*), alleviate the vitiated *Pitta* and *Vata Doshas, Jeevaniya* (increase the vital strength)[50]. It ensures that the brain receives complete nourishment and thus helps in increasing the attention span of ADHD-affected children.

***Virya*:**

Ingredients used in the preparation of trial drug compound were chiefly of *Ushna Virya. Ushna Virya* also improves blood circulation in the brain. In 1989, Lou[51] reported abnormal regional blood perfusions in the straital region of ADHD-affected children. Thus it seems that ADHD-affected children have improper perfusion as well as glucose metabolism in the brain, which should be improved by virtue of *Ushna Virya* of the trial drug.

***Doshaghnata*:**

All the drug ingredients have the property of *Kapha Vata Shamaka*. In ADHD, vitiation occurs in *Vata Dosha* that simultaneously vitiates *Pitta* and ameliorates *Kapha*. The *Kapha Vata Shamaka* effect of drugs may help in breaking the *Srotorodha* and digestion of *Ama* that leads to the proper functioning of systems of the body and brain. *Kapha Shamaka* drugs have properties that are opposite to that of *Tama Dosa*, which may help in dispelling the *Avarana* and normalizing *Tama Dohsa*, thereby maintaining the equilibrium of *Triguna* and the proper functioning of *Mana*, *Chitta* and *Buddhi*. The *Tridosha Shamaka* effect of drugs brings about homeostasis in *Tridosa* and *Triguna* as *Vata* and *Mana* interrelated with each other because Vata is responsible for vitiation of *Sharirika* as well *Manasika Dosha* and produce disease. Thus, these drugs regularize the functioning of *Mana, Sharira*, and *Manasika Dosha, Dhi, Dhriti*, and *Smriti* that are primitive seat of pathology in the treatment of ADHD.

A variety of *Ayurvedic* drugs act on the mental level. The selection of drugs for the formulation of study was based on such considerations. These drugs are known to minimize catecholaminergic (i.e., dopaminergic and noradrenergic) transmitter functions and to have an antidepressant effect. Various clinical and experimental trials of *Brahmi* have established its beneficial effect on cognition,[52] its memory-enhancing effect,[53] and its effect on ADHD.[54] *Ashwagandha* has a nootropic-like effect[55] and also has anxiolytic and antidepressant activity.[56] The other drugs used were Vacha, Jatamamsi and are known to have a beneficial effect on performance and alertness[57] as well as on GABA receptors.[58]

# RESEARCH METHODOLOGY

The research methods used in the present study were as follows:

1. Literature regarding ADHD and its management were analyzed extensively through modern and Ayurvedic texts.
2. Patients belonging to both sexes were taken.
3. As per WHO, the statistics shows that ADHD has the highest incidence and commonly affecting the school aged children of 4-12 years[1]. Hence children belonging to 7-12 years were selected for the present study.
4. Patients were also randomly selected for the study from OPD and IPD of dept of Kaumarabhrithya, S.V. Ayurvedic Hospital, Tirupathi and also from local schools of Tirupathi town.
5. Patients were selected based on the reports of the teachers of the students, having academic dullness in the class from various schools.
6. The selected patients finally were diagnosed by DSM – IV criteria and Conner's parent rating scale and full case report was prepared.
7. All the selected patients were done *Takradhara* which is processed with *churnas* of *Brahmi, Vacha, Jatamamsi and Aswagandha.*
8. Parent counseling - to understand the problem, accept the child's condition and tell them that these children need to organize for daily activities like wakeup time, meal time, bed time, etc.

**SAMPLE SIZE**: 40 patients

**DIAGNOSTIC CRITERIA:**

Based on the inclusion and exclusion criteria the patients were selected and diagnosis was made as per the scales used (DSM – IV criteria and Conner's parent rating scale)[2].

**INCLUSION CRITERIA:**

- School children of 7-12 years of age with poor academics
- Patients of both sexes.
- Patients who were fulfilling the DSM-IV criteria and Conner's parent rating scale.

**EXCLUSION CRITERIA:**

- Patients who are using other medicines.
- Children suffering from any other behavioral disorders or psychological disorders.
- Children suffering with serious illnesses like tuberculosis, malignancy etc.

**STUDY PERIOD AND FOLLOW UP:**

- Treatment was given for 14 days
- The patients were treated with 3 sittings with an interval of two months.
- Any kind of changes in the symptoms were noticed during the entire treatment.
- All the children were followed for another one month after treatment to notice any reoccurrence of the symptoms.

**ASSESSMENT CRITERIA:**

- The final assessment of therapy was done based on DSM IV criteria and Conner's parent rating scale
- Four point scoring was given for the symptoms of ADHD ranging from Never-0, Often-1, Quite often-2, Very often-3 and statistically results were drawn.

**Total Effect of Therapy**

Total effect of the therapy was calculated as follows:

DSM IV criteria (54 points)

- Cured – 91% to 100% relief (< 10 points )
- Marked improvement - 75% to 90% relief (10-20 points)
- Moderate improvement - 50% to 75% relief (21-30 points)
- Mild improvement - 25% to 50% relief (31-40 points)
- Unchanged - <25% relief (41-54 points)

Conner's Parent rating scale (42 points)

- Cured – 91% to 100% relief (< 8 points)
- Marked improvement - 75% to 90% relief (9-16 points)
- Moderate improvement - 50% to 75% relief (17-24 points)
- Mild improvement - 25% to 50% relief (25-32 points)
- Unchanged - <25% relief (33-42 points)

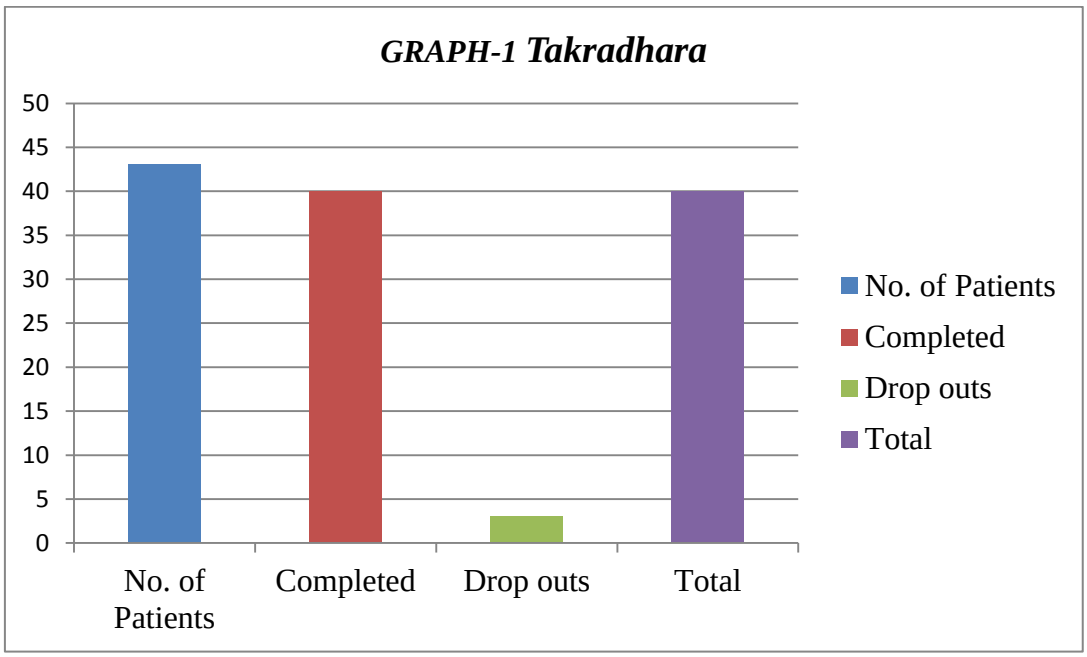
# OBSERVATIONS

For this exploratory clinical study 43 patients were registered. They were treated with *Takradhara* as a single group. The age, sex, religion, socio-economic status, dietetics, etc. noted in this study were as follows.

**Treatment Status:**

**TABLE-12 Treatment Status of 43 Patients of Attention Deficit Hyperactivity Disorder**

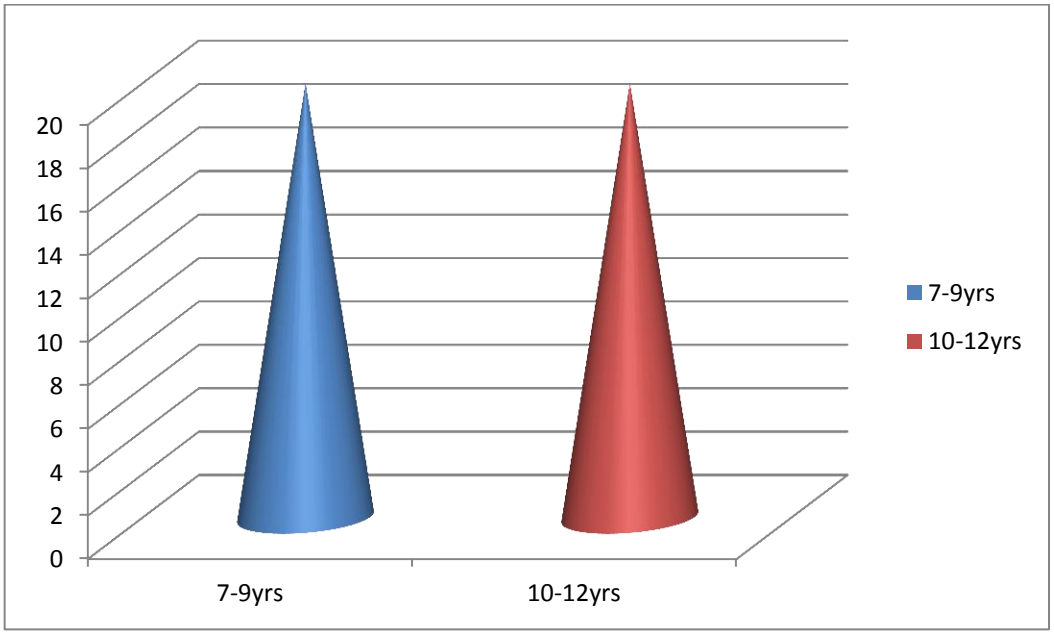
| | No. of Patients | Completed | Drop outs | Total |
|---|---|---|---|---|
| ***Takradhara*** | **43** | **40** | **03** | **40** |




In the present study 43 patients were registered among whom there were 3 dropouts during various stages of the study. Remaining 40 completed the clinical study.

**TABLE-13 Age Wise Distribution of 40 Patients of Attention Deficit Hyperactivity Disorder**

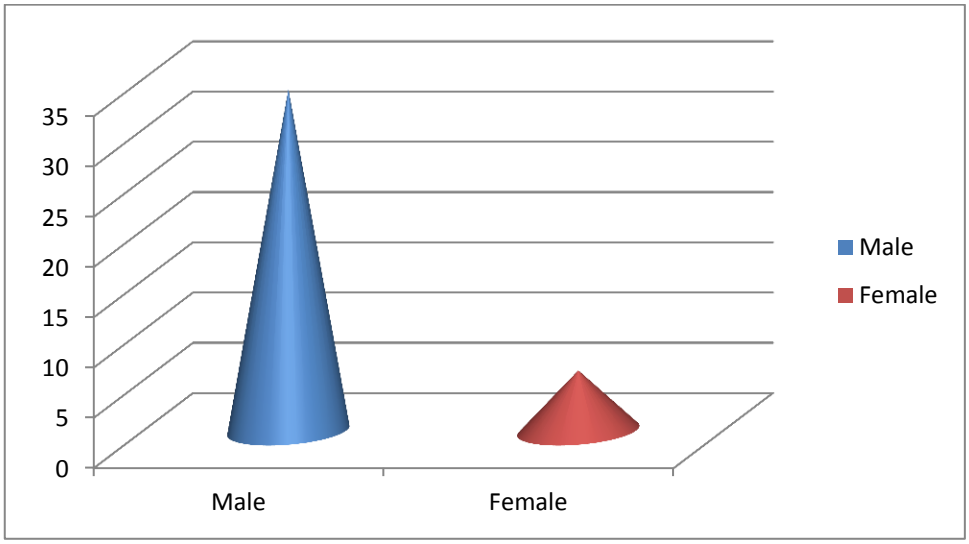
| Age in Years | No. of Patients | % |
|---|---|---|
| **A. 7-9yrs** | **20** | **50** |
| **B. 10-12yrs** | **20** | **50** |




**GRAPH-2 Age:** 50% patients were in 7-9 years age groups, followed by 50% in age group of 10-12 years.

**TABLE-14 Sex Wise Distribution of 40 Patients of Attention Deficit Hyperactivity Disorder**

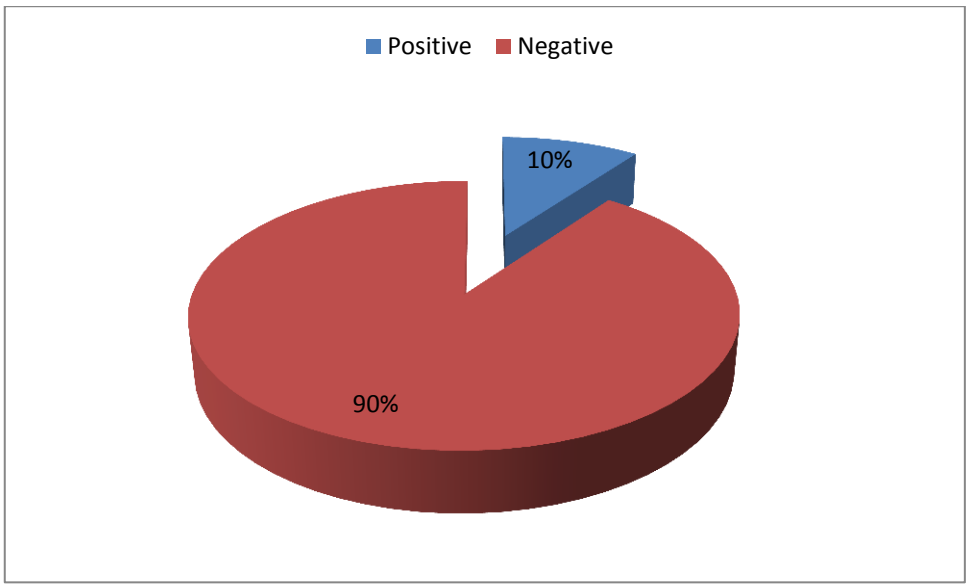
| Sex | No. of Patients | % |
|---|---|---|
| **Male** | **34** | **85** |
| **Female** | **06** | **15** |




**GRAPH-3 Sex:** 85% patients were Males and 15% were Females

**TABLE-15 Distribution of the 40 patients based on family history of Psychological illness**

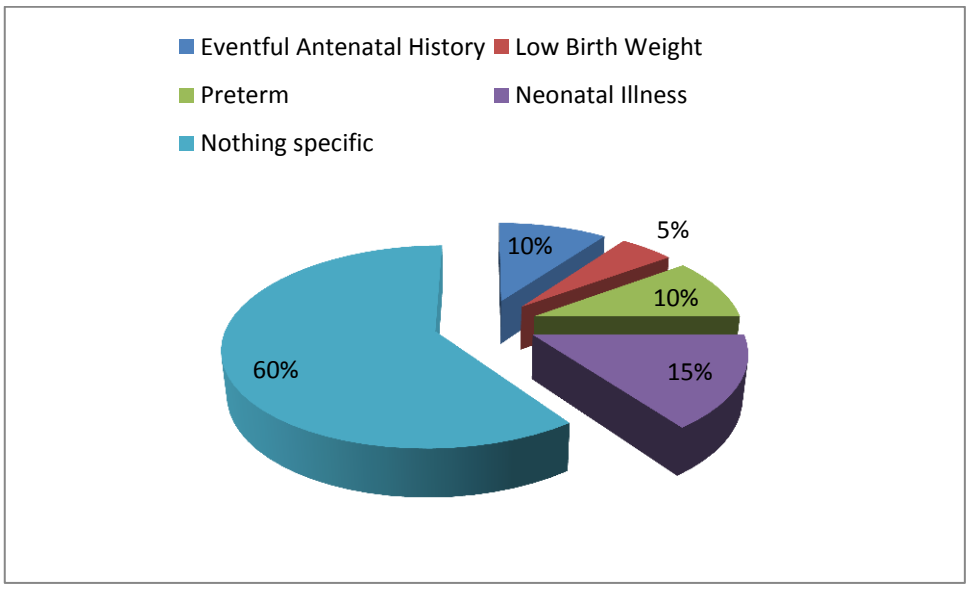
| Family history of Psychological illness | No. of Pts. | % |
|---|---|---|
| **Positive** | **4** | **10** |
| **Negative** | **36** | **90** |



**GRAPH-4 Family history of Psychological illness:** 10% of ADHD patients had positive family history and 90% were negative

**TABLE-16 Distribution of the 40 patients based on Birth History**

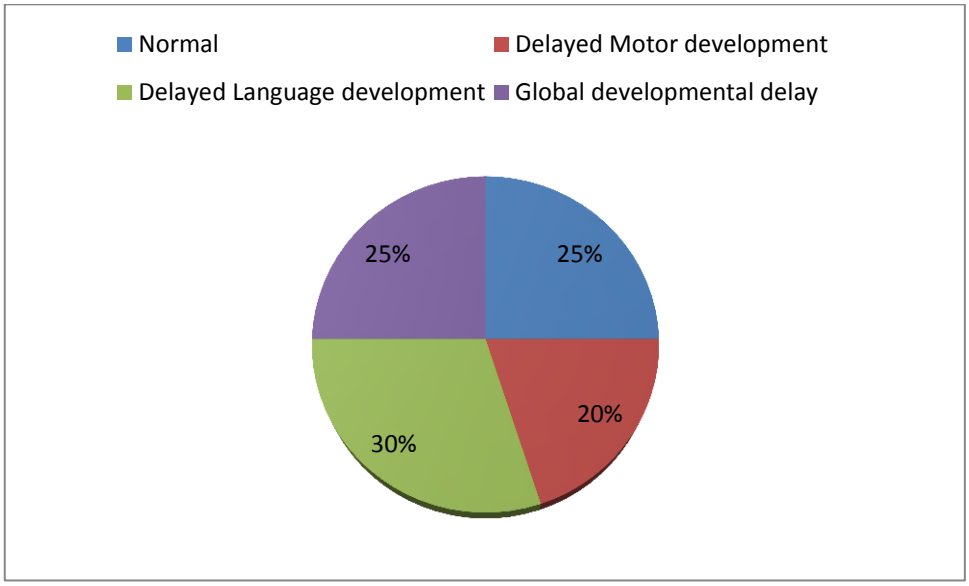
| Positive Birth History | No. of Pts. | % |
|---|---|---|
| **Eventful Antenatal History** | **4** | **10** |
| **Low Birth Weight** | **2** | **5** |
| **Preterm** | **4** | **10** |
| **Neonatal Illness** | **6** | **15** |
| **Nothing specific** | **24** | **60** |




**GRAPH-5 Birth History:** 10% of mothers of ADHD patients had eventful antenatal period like fever, hyper emesis, bleeding, hypertension etc. 5% of the patients were having Low birth weight. 10% reported premature labor. 15% reported neonatal illnesses like jaundice, respiratory distress syndrome etc, and 55% reported nothing specific.

**TABLE-17 Distribution of the 40 patients based on Developmental History**

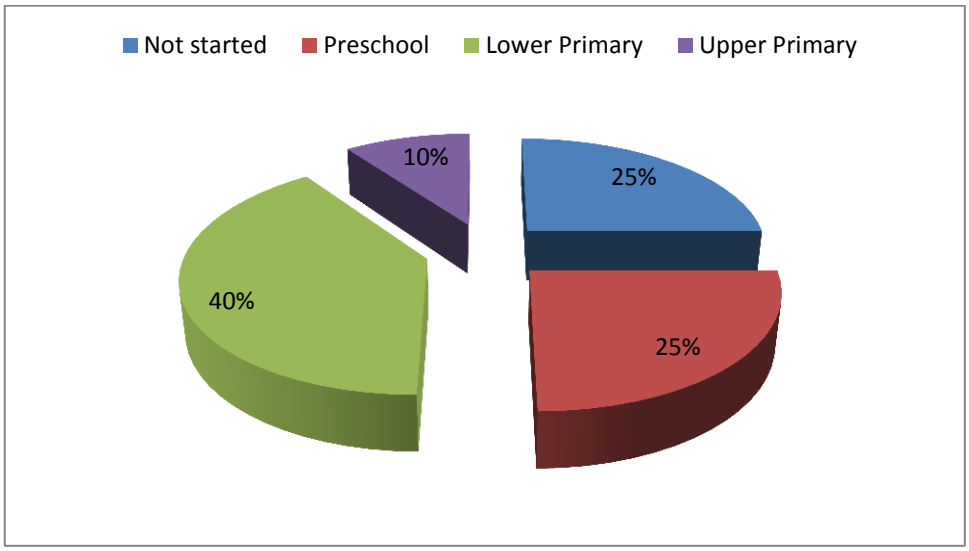
| Developmental History | No. of Pts. | % |
|---|---|---|
| **Normal** | **10** | **25** |
| **Delayed Motor development** | **08** | **20** |
| **Delayed Language development** | **12** | **30** |
| **Global developmental delay** | **10** | **25** |




**GRAPH-6 Developmental History:** 25% of the patients were developed normally, 20% of patients were having Delayed Motor development, 25% of the patients were having Global developmental delay and 30% were having Language developmental delay.

**TABLE-18 Distribution of the 40 patients based on Status of Schooling**

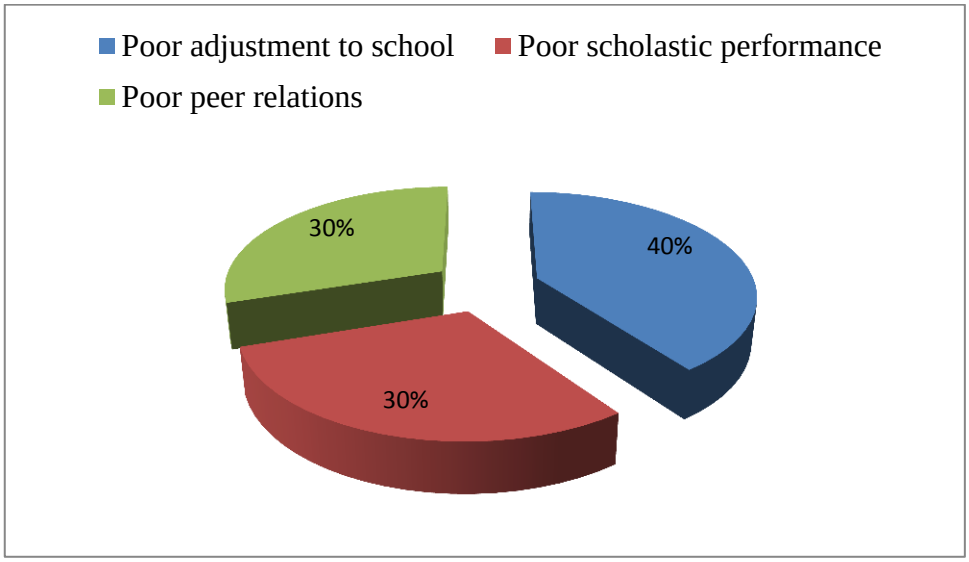
| Status of Schooling | No. of Pts. | % |
|---|---|---|
| **Not started** | **10** | **25** |
| **Preschool** | **10** | **25** |
| **Lower Primary** | **16** | **40** |
| **Upper Primary** | **4** | **10** |




**GRAPH-7 Status of Schooling:** 40% of the patients were from Lower primary level, 10% from Upper primary, 25% from preschool and 25% not started the school education.

**TABLE-19 Distribution of the 40 patients based on Status of child in School**

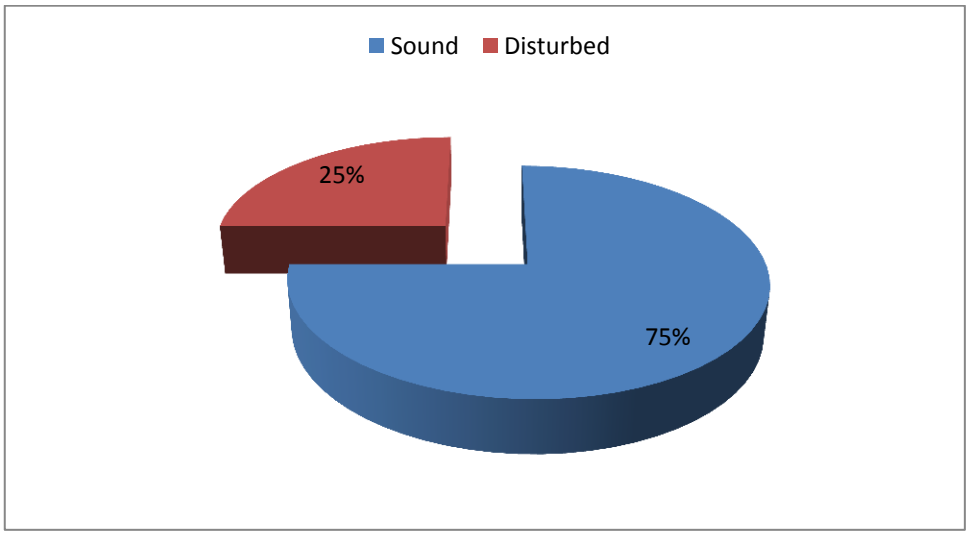
| Status of child in school | No. of Pts. | % |
|---|---|---|
| **Poor adjustment to school** | **16** | **40** |
| **Poor scholastic performance** | **12** | **30** |
| **Poor peer relations** | **12** | **30** |




**GRAPH-8 Status of child in School:** Majority of cases 40% reported poor adjustment to school, 30% showed poor scholastic performance and 30% of ADHD children had poor peer relationships.

**TABLE-20 Distribution of the 40 patients based on Sleep**

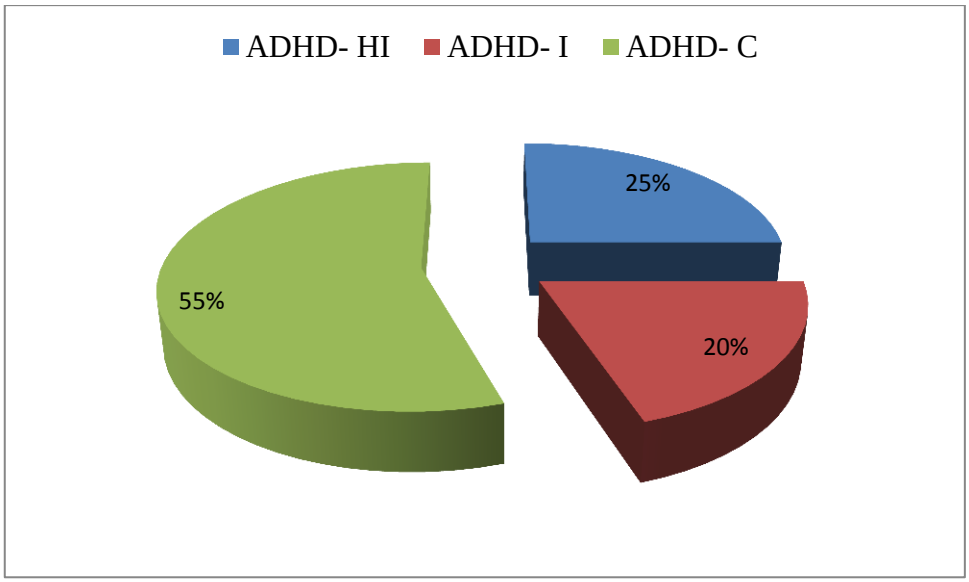
| Sleep | No. of Pts. | % |
|---|---|---|
| **Sound** | **30** | **75** |
| **Disturbed** | **10** | **25** |




**GRAPH-9 Sleep:** 25% of ADHD patients were having disturbed sleep and 75% were having Sound sleep.

**TABLE-21 Distribution of the 40 patients based on Subtypes of ADHD**

| Subtype of ADHD | No. of Pts. | % |
|---|---|---|
| **ADHD- HI** | **10** | **25** |
| **ADHD- I** | **08** | **20** |
| **ADHD- C** | **22** | **55** |




**GRAPH-10 Subtypes of ADHD:** 55% of the children were combined sub type of ADHD (ADHD-C), 20% were predominantly inattentive type of ADHD (ADHD-I) and remaining 25% were predominantly hyperactive impulsive type of ADHD-HI.

# RESULTS

## Effects of Therapy

Analysis was done from the point of view of

- Clinical condition of the patients before and after treatment procedure based on DSM IV criteria and Conner's Parent rating scale.

Effects of Therapy on ADHD patients based on DSM IV criteria are presented as under:

**TABLE-22 Effects of Therapy on Often fail to give close attention to details or makes careless mistakes in school work, work or other activities of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.80 | 1.05 | 62.5% | 0.41 | 0.50 | 0.069 | 25.238 | < 0.001 |

The mean score of Often fail to give close attention to details was reduced from 2.80 to 1.05 with mean improvement of 62.5% which was statistically significant (P < 0.001)

**TABLE-23 Effects of Therapy on Difficulty in sustaining attention in tasks or play of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.65 | 1.03 | 61.5% | 0.48 | 0.58 | 0.07 | 20.961 | < 0.001 |

The mean score of Difficulty in sustaining attention in tasks or play was reduced from 2.65 to1.03 with mean improvement of 61.5% which was statistically significant (P < 0.001)

**TABLE-24 Effects of Therapy on Often does not seem to listen of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.73 | 1.18 | 56.77% | 0.45 | 0.50 | 0.08 | 19.457 | < 0.001 |

The mean score of Often does not seem to listen was reduced from 2.73 to 1.18 with mean improvement of 56.77% which was statistically significant (P < 0.001)

**TABLE-25 Effects of Therapy on Often fails to follow instructions and finish work of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.73 | 1.28 | 53.11% | 0.45 | 0.45 | 0.08 | 18.201 | < 0.001 |

The mean score of Often fails to follow instructions and finish work was reduced from 2.73 to 1.28 with mean improvement of 53.11% which was statistically significant (P < 0.001)

**TABLE-26 Effects of Therapy on Often has difficulty in organizing tasks and activities of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.68 | 0.78 | 70.89% | 0.47 | 0.42 | 0.07 | 24.220 | < 0.001 |

The mean score of Often has difficulty in organizing tasks and activities was reduced from 2.68 to 0.78 with mean improvement of 70.89% which was statistically significant (P < 0.001)

**TABLE-27 Effects of Therapy on Often dislikes, avoids or is reluctant to engage in tasks that require sustained mental effort of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.80 | 1.05 | 62.5% | 0.41 | 0.50 | 0.06 | 25.238 | < 0.001 |

The mean score of Often dislikes, avoids or is reluctant to engage in tasks that require sustained mental effort from 2.80 to 1.05 with mean improvement of 62.5% which was statistically significant (P < 0.001)

**TABLE-28 Effects of Therapy on Often loses things necessary for tasks or activities of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.68 | 0.70 | 73.88% | 0.47 | 0.52 | 0.06 | 29.536 | < 0.001 |

The mean score of Often looses things necessary for tasks or activities was reduced from 2.68 to 0.70 with mean improvement of 73.88% which was statistically significant (P < 0.001)

**TABLE-29 Effects of Therapy on Often easily distracted by extraneous stimuli of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.63 | 0.73 | 72.24% | 0.49 | 0.51 | 0.10 | 19.000 | < 0.001 |

The mean score of Often easily distracted by extraneous stimuli was reduced from 2.63 to 0.73 with mean improvement of 72.24% which was statistically significant (P < 0.001)

**TABLE-30 Effects of Therapy on Often forgetful in daily activities of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.68 | 1.03 | 61.56% | 0.47 | 0.58 | 0.105 | 15.759 | < 0.001 |

The mean score of often forgetful in daily activities was reduced from 2.68 to 1.03 with mean improvement of 61.56% which was statistically significant (P < 0.001)

**TABLE-31 Effects of Therapy on Often fidgets with hands or feet or squirms in seat of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.70 | 1.18 | 56.66% | 0.46 | 0.50 | 0.101 | 15.069 | < 0.001 |

The mean score of Often fidgets with hands or feet or squirms in seat was reduced from 2.70 to 1.18 with mean improvement of 56.66% which was statistically significant (P < 0.001)

**TABLE-32 Effects of Therapy on Often leaves seat in classroom or in other situations in which remaining seated is expected of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.68 | 0.78 | 70.89% | 0.47 | 0.4 | 0.09 | 20.349 | < 0.001 |

The mean score of Often leaves seat in classroom or in other situations in which remaining seated is expected was reduced from 2.68 to 0.78 with mean improvement of 70.89% which was statistically significant (P < 0.001)

**TABLE-33 Effects of Therapy on Often runs about or climbs excessively in situations in which it is inappropriate of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.75 | 0.8 | 69.09% | 0.44 | 0.36 | 0.08 | 22.033 | < 0.001 |

The mean score of Often runs about or climbs excessively in situations in which it is inappropriate was reduced from 2.75 to 0.8 with mean improvement of 69.09% which was statistically significant (P < 0.001)

**TABLE-34 Effects of Therapy on Often has difficulty in playing or engaging in leisure activities quietly of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.70 | 0.78 | 71.48% | 0.46 | 0.42 | 0.07 | 25.666 | < 0.001 |

The mean score of Often has difficulty in playing or engaging in leisure activities quietly was reduced from 2.70 to 0.78 with mean improvement of 71.48% which was statistically significant (P < 0.001)

**TABLE-35 Effects of Therapy on Is often "on the go" or acts as of "driven by the motor" of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.65 | 0.80 | 69.81% | 0.48 | 0.41 | 0.07 | 24.222 | < 0.001 |

The mean score of Is often "on thle go" or acts as of "driven by the motor" was reduced from 2.65 to 0.80 with mean improvement of 69.81% which was statistically significant (P < 0.001)

**TABLE-36 Effects of Therapy on Often talks excessively of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.75 | 0.85 | 69.09% | 0.44 | 0.36 | 0.04 | 39.551 | < 0.001 |

The mean score of Often talks excessively was reduced from 2.75 to 0.85 with mean improvement of 69.09% which was statistically significant (P < 0.001)

**TABLE-37 Effects of Therapy on Often blurts out answers before questions have been completed of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.68 | 0.75 | 72.01% | 0.53 | 0.44 | 0.07 | 25.666 | < 0.001 |

The mean score of Often blurts out answers before questions have been completed was reduced from 2.68 to 0.75 with mean improvement of 72.01% which was statistically significant (P < 0.001)

**TABLE-38 Effects of Therapy on Often has difficulty in awaiting turn of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.05 | 0.75 | 68.48% | 0.78 | 0.44 | 0.07 | 20.961 | < 0.001 |

The mean score of Often has difficulty in awaiting turn was reduced from 2.05 to 0.75 with mean improvement of 68.48% which was statistically significant (P < 0.001)

**TABLE-39 Effects of Therapy on Often interrupts or intrudes on others of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.23 | 0.85 | 61.88% | 0.58 | 0.48 | 0.07 | 17.737 | < 0.001 |

The mean score of Often interrupts or intrudes on others was reduced from 2.23 to 0.85 with mean improvement of 61.88% which was statistically significant (P < 0.001)

## Effects of Therapy (CONNERS PARENT RATING scale)

Effects of Therapy on ADHD patients based on CONNERS PARENT RATING scale are presented as under:

**TABLE-40 Effects of Therapy on Often fidgets with hands or feet or squirms in seat of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.38 | 0.83 | 65.12% | 0.74 | 0.50 | 0.08 | 17.746 | < 0.001 |

The mean score of Often fidgets with hands or feet or squirms in seat was reduced from 2.38 to 0.83 with mean improvement of 65.12% which was statistically significant (P < 0.001)

**TABLE-41 Effects of Therapy on Often has difficulty remaining seated of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.68 | 0.90 | 66.41% | 0.47 | 0.30 | 0.06 | 26.545 | < 0.001 |

The mean score of Often has difficulty remaining seated was reduced from 2.68 to 0.90 with mean improvement of 66.41% which was statistically significant (P < 0.001)

**TABLE-42 Effects of Therapy on Often is easily distracted of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.63 | 0.93 | 64.63% | 0.49 | 0.35 | 0.07 | 23.167 | < 0.001 |

The mean score of Often is easily distracted was reduced from 2.63 to 0.93 with mean improvement of 64.63% which was statistically significant (P < 0.001)

**TABLE-43 Effects of Therapy on has difficulty awaiting turn in groups of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.80 | 0.73 | 64.90% | 0.76 | 0.45 | 0.07 | 17.675 | < 0.001 |

The mean score of has difficulty awaiting turn in groups was reduced from 2.80 to 0.73 with mean improvement of 64.90% which was statistically significant (P < 0.001)

**TABLE-44 Effects of Therapy on Often blurts out answers to questions of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.68 | 0.83 | 69.02% | 0.53 | 0.38 | 0.05 | 32.355 | < 0.001 |

The mean score of Often blurts out answers to questions was reduced from 2.68 to 0.83 with mean improvement of 69.02% which was statistically significant (P < 0.001)

**TABLE-45 Effects of Therapy on Often has difficulty following instructions in of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.73 | 1.13 | 58.60% | 0.45 | 0.33 | 0.07 | 20.396 | < 0.001 |

The mean score of Often has difficulty following instructions was reduced from 2.73 to 1.13 with mean improvement of 58.60% which was statistically significant (P < 0.001)

**TABLE-46 Effects of Therapy on has difficulty sustaining attention to tasks of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.65 | 1.03 | 61.50% | 0.48 | 0.53 | 0.07 | 20.961 | < 0.001 |

The mean score of has difficulty sustaining attention to tasks was reduced from 2.65 to 1.03 with mean improvement of 61.50% which was statistically significant (P < 0.001)

**TABLE-47 Effects of Therapy on Often shifts from one uncompleted activity to another of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.50 | 0.85 | 66% | 0.64 | 0.43 | 0.08 | 19.560 | < 0.001 |

The mean score of Often shifts from one uncompleted activity was reduced from 2.50 to 0.85 with mean improvement of 66% which was statistically significant (P < 0.001)

**TABLE-48 Effects of Therapy on Often has difficulty playing quietly of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.70 | 0.85 | 68.51% | 0.46 | 0.36 | 0.06 | 27.422 | < 0.001 |

The mean score of Often has difficulty playing quietly was reduced from 2.70 to 0.85 with mean improvement of 68.51% which was statistically significant (P < 0.001)

**TABLE-49 Effects of Therapy on Often talks excessively of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.75 | 0.93 | 66.54% | 0.44 | 0.27 | 0.06 | 29.995 | < 0.001 |

The mean score of Often talks excessively was reduced from 2.75 to 0.93 with mean improvement of 66.54% which was statistically significant (P < 0.001)

**TABLE-50 Effects of Therapy on Often interrupts or intrudes on others of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.00 | 0.60 | 70% | 0.75 | 0.50 | 0.07 | 17.846 | < 0.001 |

The mean score of Often interrupts or intrudes on others was reduced from 2.00 to 0.60 with mean improvement of 70% which was statistically significant (P < 0.001)

**TABLE-51 Effects of Therapy on Often does not seem to listen of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.73 | 1.18 | 56.77% | 0.45 | 0.50 | 0.08 | 19.457 | < 0.001 |

The mean score of Often does not seem to listen was reduced from 2.73 to 1.18 with mean improvement of 56.77% which was statistically significant (P < 0.001)

**TABLE-52 Effects of Therapy on Often loses things necessary for tasks of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.68 | 0.83 | 69.02% | 0.47 | 0.45 | 0.05 | 32.355 | < 0.001 |

The mean score of Often loses things necessary for tasks was reduced from 2.68 to 0.83 with mean improvement of 69.02% which was statistically significant (P < 0.001)

**TABLE-53 Effects of Therapy on Often engages in physically dangerous activities without considering consequences of 40 patients of ADHD**

| n | Mean | | % | SD | | SE | 't' Value | 'p' Value |
|---|---|---|---|---|---|---|---|---|
| | BT | AT | | BT | AT | | | |
| 40 | 2.40 | 0.78 | 67.91% | 0.67 | 0.48 | 0.08 | 19.030 | < 0.001 |

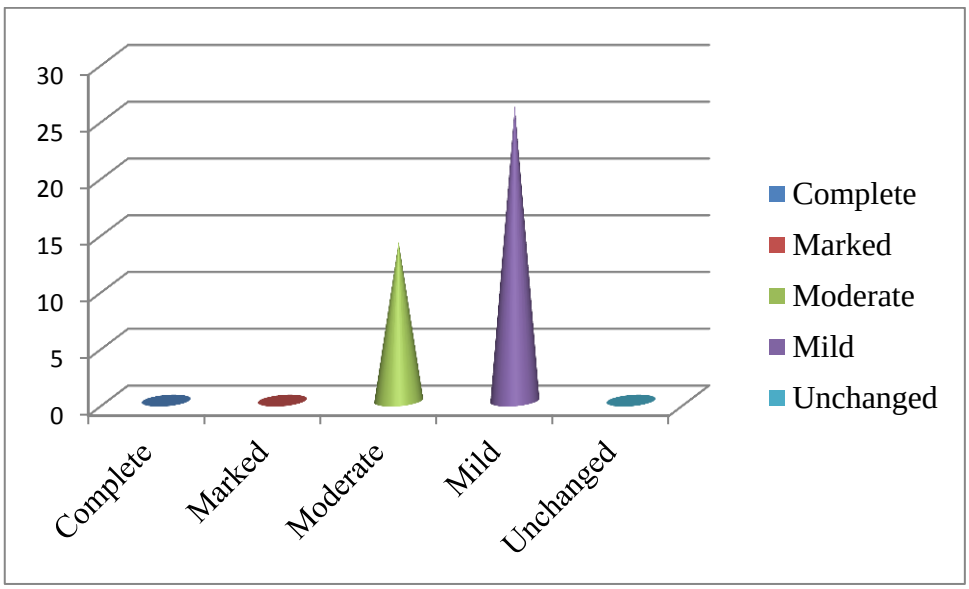
The mean score of Often engages in physically dangerous activities without considering consequences was reduced from 2.40 to 0.78 with mean improvement of 67.91% which was statistically significant (P < 0.001)

**Total Effects of Therapy**

A. Based on DSM IV Criteria

**TABLE-54**

| Result | No. of Patients | % |
|---|---|---|
| Complete | 0 | 0 |
| Marked | 0 | 0 |
| Moderate | 14 | 35 |
| Mild | 26 | 65 |
| Unchanged | 0 | 0 |

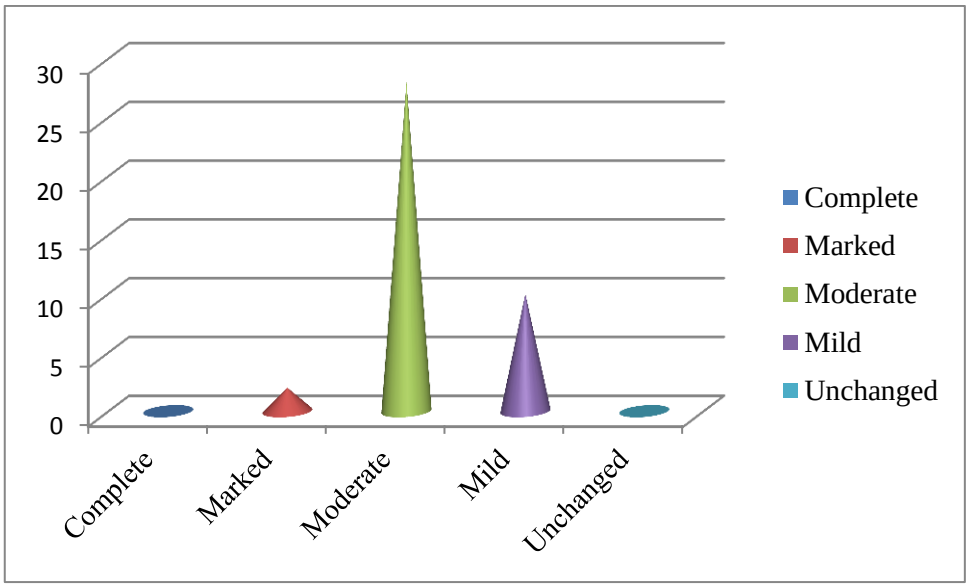



**GRAPH-11** In a sample size of 40 patients, 14 patients (35%) were shown Moderate improvement, 26 patients (65%) showed Mild improvement.

B. Based on Conner's Parent Rating scale

**TABLE-55**

| Result | No. of Patients | % |
|---|---|---|
| Complete | 0 | 0 |
| Marked | 2 | 5% |
| Moderate | 28 | 70% |
| Mild | 10 | 10% |
| Unchanged | 0 | 0 |




**GRAPH-12** In a sample size of 40 patients 2 patients (5%) were shown Marked improvement, 28 patients (70%) showed Moderate improvement, 10 patients (10%) showed Mild improvement.

# DISCUSSION

Children are almost as different as adults in many aspects. The importance of childhood has been emphasized from the literature right up to the medical science since decades. Every incidence in the childhood has an influence on the adult life. A healthy childhood is healthy adulthood. The importance of childhood is well dealt in *Kaumarabhritya.*

*Acharya Kashyapa* has discussed everything about child in *Kashyapa Samhitha*. The concept of child psychology in *Ayurveda* is scattered throughout the Ayurvedic literature. A thorough understanding of the concepts of *Kaumarabhritya* is a prerequisite to understand any disease that is occurring in child. Most of the diseases are psychosomatic in nature. Therefore, the incidence of psychiatric disorders in children has become one of the causes of morbidity in children.

The psychiatric disorders which affect certain mental activities of the child, which interfere with their development, slowdown their education and compromise their future day by day. Children constitute about 40% of our population; hence child mental health becomes an important issue in India. The psychosomatic disorders like ADHD can devastate the life of the child as it persist into adulthood leading to problems in society. Therefore it is necessary to study this disease in *Ayurvedic* point of view, which would be helpful in creating awareness about the disease in the society, and also aid in early intervention and help to guide the parents about the condition of the child.

The shortcomings and complications of the modern medicines have placed greater responsibilities on the *Ayurveda* for providing effective management in psychosomatic disorders like ADHD. The *Ayurvedic* concepts like *Manas* play a role in *Manasika vikaras* like ADHD and few treatments which are effective and safe in the management of such psychosomatic disorders in *Ayurveda* are a ray hope for establishing the mental health of child.

So in the present study the disease ADHD was selected for its detail study in *Ayurvedic* parameters and also to study the effect of *Takradhara* in management of ADHD.

The study was carried out to assess the efficacy of *Takradhara* in Attention Deficit Hyperactivity Disorder in children of 7-12 years age. The trial was intended to study ADHD in *Ayurvedic* point of view and a possible solution for it using *Ayurvedic* treatment principles. Moreover the numbers of studies on ADHD in children with *Ayurvedic* interventions were least common.

Forty patients were selected for the clinical study. Selected treatment modalities – *Takradhara* was done in the patients and data was collected before treatment, after treatment and after follow up. All these data were statistically analyzed and discussed in detail and the outcome is presented below.

**DISCUSSION ON DISEASE**

**Concept of *Manas***

- Understanding of the concepts of *Manas*, its functions, normalcy and abnormalcy of *Manas*, *Doshas of Manas* is a prerequisite to understand the psychopathology of *Manasa Vikaras*.

- The interpretation of the human psyche and its relationship with body is one of the most important issues in understanding the psychopathology of the diseases in our science. The profounder of *Ayurveda* were probably the first who have detailed description of mind body relationship.

- The functions of the *Manas* - *Manas Karma* and its objects - *Mano arthas* are most vital aspects of *Manas* in determining its normal functioning. By virtue of which *Manas* is endowed with the capacity of concentrating, controlling the sense organs, thinking, judgement, argument and conclusion. These are further influenced by the volitional power of the *Manas* - *the Buddhi*. *Buddhi* discriminates between the *Karya* and *Akarya* and *Shubha* and *Ashubha*. It is because of this discriminating faculty that the *Manas* is spoken as *Buddhi*.

- The understanding of entire physiology of the process of perception of knowledge - *Jnanotpatti* is thus critical in identifying the levels of impairment of these functions of *Manas* in a diseases condition. The *Sharira* and *Mano Dosha* in their relative ratios to one another under normal conditions influence the quality of *Manas* functions and are responsible for abnormality when their homeostasis is lost. Certain influence of these *Doshas* is already present since birth, which has been described in terms of *Prakriti. Charak Acharya* has rightly provided a rationale to the description of certain abnormal behaviors under the *Prakriti*. He has opined that all variants of *Sharira* and *Manas Prakrit*i except the *Sama Prakriti* are *Vikriti* - abnormalities, due to the clear dominance of any one particular *Doshas* over the others. The individuals carrying the traits of these *Prakritis* will be more susceptible to the psychological disorders.

**Disease Review**

- With the advancement in day today's human life the diseases are also advancing. Due to more stressful and speedy life, the Psychiatric illness are broadening in adults as well as in children, among which ADHD is most common wide spread psychiatric disease affecting children in all over the world. The disease ADHD came into much light mainly due to the demarcation of its diagnostic criteria by the APA in DSM-IV due to which the diagnosis of this disease became simpler. Yet it is worth mentioning that the understanding about this disease has changed tremendously over the last century from being called as "Morbid defects in moral control" to its present nomenclature as AD/HD.

- ADHD is co morbid with many childhood disorders like conduct disorders, anxiety disorders etc. The management of such condition becomes very challenging as it requires treatment of both the disorders to be successful. The current options for pharmacological and non pharmacological treatment of the disease has got its own positive and negative aspects. On one hand where Cognitive behavioral therapies have been successfully used in majority cases,

the commonly used Stimulant medications are becoming notorious for their side effects and rise in substance abuse among children.

- An understanding of the etiological aspects of ADHD may provide better planning of the treatment and prevention. A review of the etiological factors of the disease explains its heterogeneity. No single cause commonly among the various samples of the population studied so far. Among the established etiological factors antenatal and perinatal complications were those which could contribute largely to the manifestation of ADHD. Another disputable factor 'food additives' which is still a controversy and requires more study regarding its relationship with the disease. The increasing incidence of ADHD can be attributed to the increased exposure to these risk factors both the genetic and environmental both during the prenatal and postnatal life of the child.

- Though the disease ADHD is not mentioned in *Ayurveda* its psychopathology can be understood applying the basic concepts of disease genesis in *Ayurveda.* While understanding the *Nidana panchaka* of the disease, various factors which determine the nature of temperament and later on affect its development are important to identify the etiological factors. These are genetic or *Sahaja* factors and the other factors like *Garbhaja, Janmottara* and *Agantuja* have been described in the classical texts of various instances. Even a genetically normal child can develop the disease ADHD due to the various factors, which affect the early foundations of the Child's development.

- The clinical presentation of the disease with the three cardinal symptoms i.e. Inattention, Hyperactivity and impulsivity points towards the abnormality of behaviors due to defects in the volitional powers of the mind. Much of the description of disease matches with that of *Prajnaparadha* in our classics. *Prajnaparadha* which is the result of *Dhee, Dhriti* and *Smriti Vibhramsha* can to a great extent explain the disease ADHD. Though *Prajnaparadha* has been mentioned as one of the causes of disease the individual descriptions of *Dhee, Dhriti* and *Smriti Vibhramsa* are very similar with the presentation of ADHD.

And these three constituents of *Prajna* are the major factors in the psychopathology of this disease.

- No single laboratory study was found helpful in diagnosing the disease. However Neuroimaging studies have been successful in identifying structural, functional and physiological changes in the brain. Children with ADHD have approximately a 5–10% reduction in the brain structures, [1] abnormality in brain functions (cognitive dysfunction) and abnormalities in Neurochemical brain system i.e. the Neurotransmitters like Dopamine (DA) and Norepinephrine (NE), which are implicated in the pathophysiology of ADHD[2].

- Affected children commonly experience academic underachievement, problems with interpersonal relationships with family members and peers, and low self-esteem. They have a hard time in controlling their impulses and regulating their activity, attention. In brief this picture of the disease can be correlated with the few *lakshanas* of *Manasa Vikaras* described by *Acharya Charaka* which occur due to defects in the volitional power of the *Manas* i.e. the *Buddhi* or its constituents, the *Dhee, Dhriti* and *Smriti*. Along with *Manasika doshas (Rajas and Tamas), Shareerika doshas (Vata, Pitta, Kapha)* play a role in causing psychosomatic disorders, especially *Vata dosha* deranges the functions of *Manas* leading to *Dhee, Dhriti* and *Smritivibhramsha* and can be compared with the symptoms of ADHD i.e. Inattention, Hyperactivity and Impulsivity.

- The characters of Inattention - Easily distracted, forgetting in daily activities, making careless mistakes in school activities, loosing things, difficulty in organizing tasks etc.all were seen in *Vibramsha* of *Dhee, Dhriti,* and *Smriti.*

- The characters of Hyperactivity - running or climbing excessively, Fidgets with hands or feet or squirms in chair, talking excessively etc. can be correlated with the lakshnas of *Chesta Vibramha* i.e. *Chapala Chesta, Chalam Asthiram, Bahu bhashitam.*

- The characters of Impulsivity - Blurts out answers before questions have been completed,

  difficulty in waiting or taking turn can be correlated with *Austukyam* ( indulging in activities without thinking).

- As per *Ayurveda* - The *Adhisthana* of all the *Indriyas* is *Shira*. *Chakrapani* has mentioned *"Indriyadhisthanam Manasa Karma"* – controlling of *Indriyas* is the *Karma* of *Manas.* The chief location of *Vata* is upper portion of *Mastiska* (*Atharvaveda*). It is also the main seat of *Prana Vayu* which controls *Manas.*

- Thus the ADHD can be compared and treated similar to that of *Manasa Vikaras* and overall when the pathophysiology of the disease is considered, both sciences emphasize that *adhistana* of disease is *Shira* (Head), hence choosing *Shirodhara m*ay be more appropriate in this study.

**DISCUSSION ON DRUG REVIEW**

- In the study *Takra* processed with *Brahmi, Jatamamsi*, *Vacha, Aswagandha churnas* was taken for *Shirodhara. Takradhara* causes the pacification of vitiated *Vata*, it is *Indriya Prasadana*, produces relaxing effect, enhance the alertness and concentration abilities, improves cerebral function and anxiolytic action[4].

- *Brahmi, Jatamamsi*, *Vacha*, and *Aswagandha* are well known nootropic drug and a potent medhya rasayana. The drugs were thus chosen for the present research work. A review of the various research works done on the drugs show that they have the capacity to improve the higher cognitive functions of the brain.

**DISCUSSION ON DEMOGRAPHIC DATA**

**Age:** The demographic data showed that 50% were of 7-9 years and remaining 50% of 10-12 years age. This shows that in the school aged children the disease ADHD is identified because it affects the academic performance of the child.

**Sex:** Among the total of 40 patients 85% of patients were male and 15% were female. The ratio of Males and Females is 5.6:1. Studies have shown that girls with ADHD are predominantly inattentive type and show lesser level of hyperactivity, learning disability and intellectual impairment and boys with ADHD are predominantly hyperactive.

**Family history of Psychiatric illness:** In the present study, 10% of the ADHD children showed positive family history of Psychiatric illness. Research works have shown that such a positive history is one of the risk factors for ADHD in children. So the present study also is in consistent with earlier studies.

**Birth History:** Out of 40 patients, 10% of the patient's mothers were having eventful antenatal period like bleeding PV, Fever, Hyper emesis, Hypertension etc, 10% reported Premature labor, 5% of the patients were born with Low Birth Weight and 15% reported neonatal illnesses like respiratory distress, jaundice etc. Research findings suggest that a variety of brain insults that include perinatal and antenatal hypoxia and other obstetrical trauma, premature delivery, low birth weight, clinical nutritional deficiency, cause subtle brain damage and associated with an increased risk for ADHD. The present study also confirms the same to some extent.

**Developmental history:** In the present study 55% of cases presented with the history of delayed milestones in which 30% showed developmental delay in speech and language and 25% showed delay in global development. Kapur et al in 1995 reported that delayed developmental mile stones, motor development and speech were significantly associated with disease.

**History of Status of child in School:** In the study 40% of cases reported poor adjustment to school, 30% showed poor scholastic performance and 30% of ADHD children had poor peer relationships. These were in confirmation with the fact that children with ADHD tend to show pervasive problems in social adjustment. Relative to other children they have few friends and experience high rates of peer rejection. ADHD children have inattention, difficulty with decision making and planning, faulty judgment, difficulty in reading, writing, calculations and language skills, low self

esteem, aggression, hyperactivity, etc; resulting in poor scholastic performance leading to early school termination, rejection by peers and other consequences.

**Subtypes of ADHD:** Regarding the subtypes of ADHD, combined type occurs most commonly out of the three followed by inattentive type and hyperactive impulsive type (APA, 1994). Out of 40 subjects in the study, 55% of the children were combined sub type of ADHD (ADHD-C), 20% were predominantly inattentive type of ADHD (ADHD-I) and remaining 25% were predominantly hyperactive impulsive type of ADHD-HI.

**DISCUSSION ON RESULTS:**

The effect of therapy was calculated using the four point rating scales based on DSM IV criteria and Conner's Parent Rating Scale for ADHD. The mean scores before and after the intervention were noted and relief in percentage was calculated. For analyzing the data before and after treatment Wilcoxon signed rank test was used.

TABLE-56 Effect of therapy based on DSM - IV criteria:

| **Parameters** | **n** | **Mean** | | **%** | **SD** | | **SE** | **'t' value** | **'p' value** |
|---|---|---|---|---|---|---|---|---|---|
| | | **BT** | **AT** | | **BT** | **AT** | | | |
| Fail to give details | 40 | 2.80 | 1.05 | 62.5% | 0.41 | 0.50 | 0.069 | 25.238 | < 0.001 |
| Difficulty in sustaining attention | 40 | 2.65 | 1.03 | 61.5% | 0.48 | 0.58 | 0.07 | 20.961 | < 0.001 |
| Not seem to listen | 40 | 2.73 | 1.18 | 56.77% | 0.45 | 0.50 | 0.08 | 19.457 | < 0.001 |
| Fails to follow instructions and finish work | 40 | 2.73 | 1.28 | 53.11% | 0.45 | 0.45 | 0.08 | 18.201 | < 0.001 |
| Difficulty in organizing tasks | 40 | 2.68 | 0.78 | 70.89% | 0.47 | 0.42 | 0.07 | 24.220 | < 0.001 |
| Dislikes, avoids or is reluctant to engage in tasks | 40 | 2.80 | 1.05 | 62.5% | 0.41 | 0.50 | 0.06 | 25.238 | < 0.001 |
| Often looses things | 40 | 2.68 | 0.70 | 73.88% | 0.47 | 0.52 | 0.06 | 29.536 | < 0.001 |
| Often easily distracted | 40 | 2.63 | 0.73 | 72.24% | 0.49 | 0.51 | 0.10 | 19.000 | < 0.001 |
| often forgetful | 40 | 2.68 | 1.03 | 61.56% | 0.47 | 0.58 | 0.105 | 15.759 | < 0.001 |
| Often fidgets | 40 | 2.70 | 1.18 | 56.66% | 0.46 | 0.50 | 0.101 | 15.069 | < 0.001 |
| Often leaves seat in classroom | 40 | 2.68 | 0.78 | 70.89% | 0.47 | 0.4 | 0.09 | 20.349 | < 0.001 |
| Often runs about or climbs | 40 | 2.75 | 0.8 | 69.09% | 0.44 | 0.36 | 0.08 | 22.033 | < 0.001 |
| Often has difficulty in playing | 40 | 2.70 | 0.78 | 71.48% | 0.46 | 0.42 | 0.07 | 25.666 | < 0.001 |
| Often "on the go" or acts as of "driven by the motor" | 40 | 2.65 | 0.80 | 69.81% | 0.48 | 0.41 | 0.07 | 24.222 | < 0.001 |
| Often talks excessively | 40 | 2.75 | 0.85 | 69.09% | 0.44 | 0.36 | 0.04 | 39.551 | < 0.001 |
| Often blurts out answers before questions | 40 | 2.68 | 0.75 | 72.01% | 0.53 | 0.44 | 0.07 | 25.666 | < 0.001 |
| has difficulty in awaiting turn | 40 | 2.05 | 0.75 | 68.48% | 0.78 | 0.44 | 0.07 | 20.961 | < 0.001 |
| Often interrupts or intrudes on others | 40 | 2.23 | 0.85 | 61.88% | 0.58 | 0.48 | 0.07 | 17.737 | < 0.001 |

1. Inattention:

Maximum relief was observed in the criteria of Inattention. The relief was highest - 73.88% in (g) often loses things followed by 72.24% relief in (h) often easily distracted, 70.89% relief was observed in (e) difficulty in organizing tasks, 62.5% relief was obtained in (a) failure to give close attention to details and in (f) Often avoids, dislikes, or is reluctant to engage in tasks 61.5% relief was seen in (b) difficulty in sustaining attention and (i) often forgetful. Except (c) not seem to listen and (d) fails to follow instructions, the changes were statistically highly significant comparatively.

2. Hyperactivity:

A highest i.e. 71.48% relief was found in (d) often has difficulty in playing, 70.89% relief was observed in (b) often leaves seat and 69.81% relief was observed in (e) as if ' driven by a motor ' symptom of Hyperactivity. The changes in other criteria showed statistically less significant levels.

3. Impulsivity:

In the criteria for impulsivity 72% relief was observed in (g) blurting out of answers, 68.48% relief was found in (h) difficulty in awaiting turn and 61.88% relief were obtained in (i) interrupting others.

TABLE-57 Effect of therapy based on Conner's Parent Rating Scale:

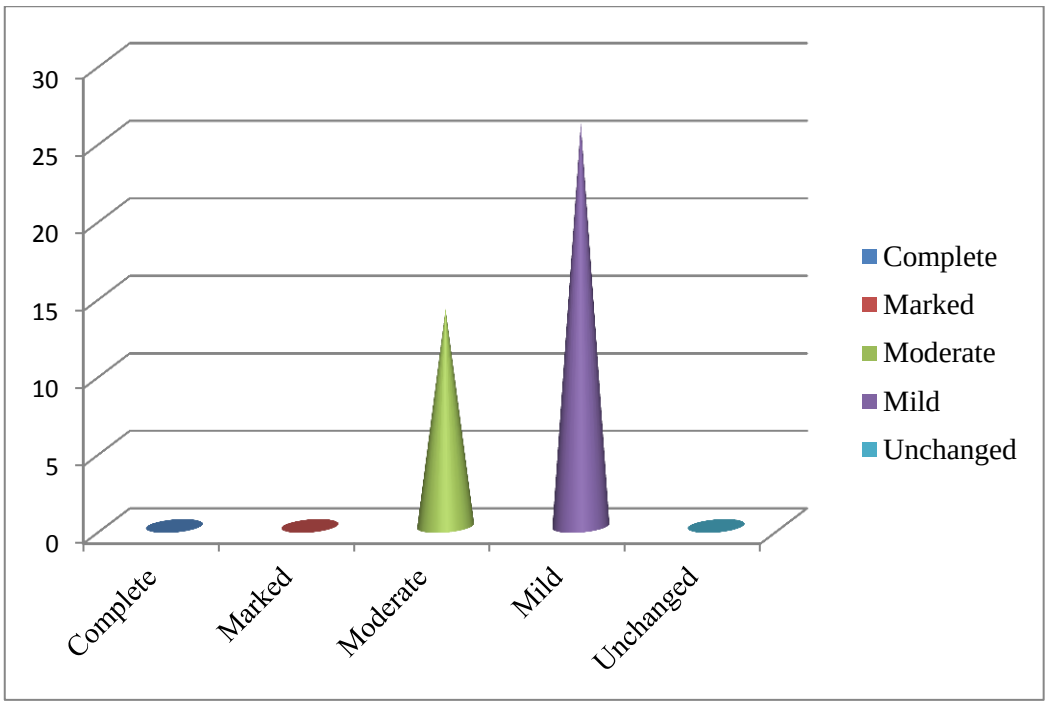
| **Parameters** | **n** | **Mean** | | **%** | **SD** | | **SE** | **'t' value** | **'p' value** |
|---|---|---|---|---|---|---|---|---|---|
| | | **BT** | **AT** | | **BT** | **AT** | | | |
| Often fidgets or squirms | 40 | 2.38 | 0.83 | 65.12% | 0.74 | 0.50 | 0.08 | 17.746 | < 0.001 |
| Has difficulty remaining seated | 40 | 2.68 | 0.90 | 66.41% | 0.47 | 0.30 | 0.06 | 26.545 | < 0.001 |
| Easily distracted | 40 | 2.63 | 0.93 | 64.63% | 0.49 | 0.35 | 0.07 | 23.167 | < 0.001 |
| Has difficulty awaiting turn in groups | 40 | 2.80 | 0.73 | 64.90% | 0.76 | 0.45 | 0.07 | 17.675 | < 0.001 |
| Often blurts out answers | 40 | 2.68 | 0.83 | 69.02% | 0.53 | 0.38 | 0.05 | 32.355 | < 0.001 |
| Has difficulty following instructions | 40 | 2.73 | 1.13 | 58.60% | 0.45 | 0.33 | 0.07 | 20.396 | < 0.001 |
| Has difficulty sustaining attention to tasks | 40 | 2.65 | 1.03 | 61.50% | 0.48 | 0.53 | 0.07 | 20.961 | < 0.001 |
| Often shifts from one uncompleted activity to another | 40 | 2.50 | 0.85 | 66% | 0.64 | 0.43 | 0.08 | 19.560 | < 0.001 |
| Often has difficulty playing quietly | 40 | 2.70 | 0.85 | 68.51% | 0.46 | 0.36 | 0.06 | 27.422 | < 0.001 |
| Often talks excessively | 40 | 2.75 | 0.93 | 66.54% | 0.44 | 0.27 | 0.06 | 29.995 | < 0.001 |
| Often interrupts or intrudes on others | 40 | 2.00 | 0.60 | 70% | 0.75 | 0.50 | 0.07 | 17.846 | < 0.001 |
| Often does not seem to listen | 40 | 2.73 | 1.18 | 56.77% | 0.45 | 0.50 | 0.08 | 19.457 | < 0.001 |
| Looses things necessary for tasks | 40 | 2.68 | 0.83 | 69.02% | 0.47 | 0.45 | 0.05 | 32.355 | < 0.001 |
| Engages in physically dangerous activities | 40 | 2.40 | 0.78 | 67.91% | 0.67 | 0.48 | 0.08 | 19.030 | < 0.001 |

Maximum relief observed in this scale: The relief was highest – 70% in (11) Often interrupts or intrudes on others followed by 69.02% relief in (5) often blurts out answers to questions, 68.5% relief in (9) often has difficulty playing quietly and much relief was not found in other features.

**Total Effects of Therapy**

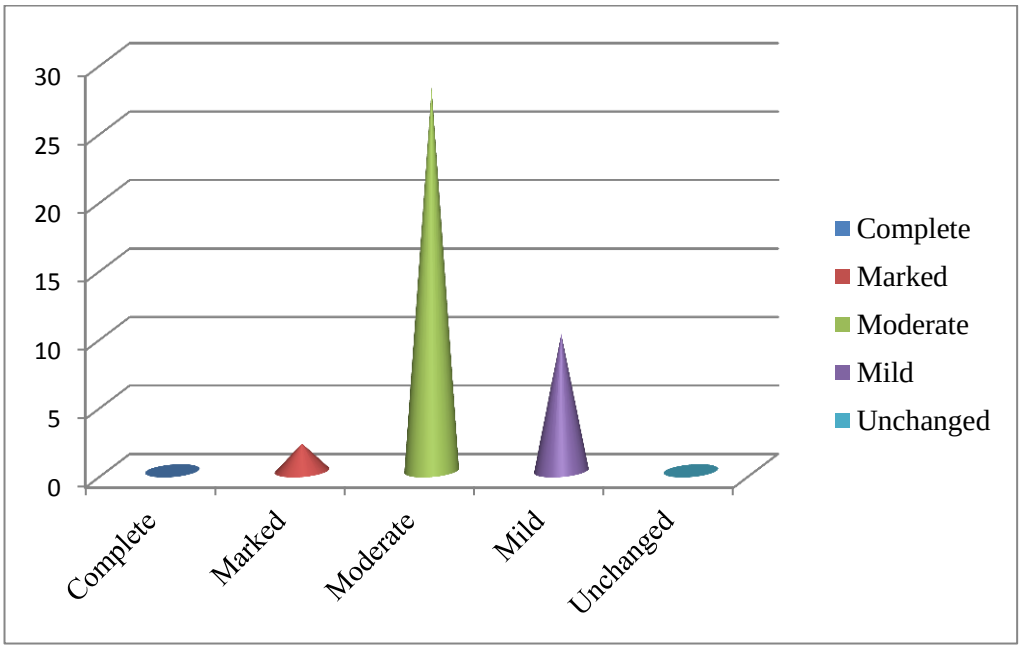
Total effect of therapy on 40 patients of ADHD was calculated by taking the mean of % of relief based on the four point rating of the DSM-IV items and Conner's Parent Rating Scale. In the group statistically highly significant change (p = <0.001) was observed in the symptoms of ADHD. There was considerable decrease in symptoms of diseases after treatment. This improvement can be attributed to *Takradhara* procedure. In the present study, overall result shows that none of them got complete cure or marked improvement but got moderate improvement to mild improvement after treatment.

A. Based on DSM IV Criteria




In a sample size of 40 patients, 14 patients (35%) were shown Moderate improvement, 26 patients (65%) showed Mild improvement.

B. Based on Conner's Parent Rating scale



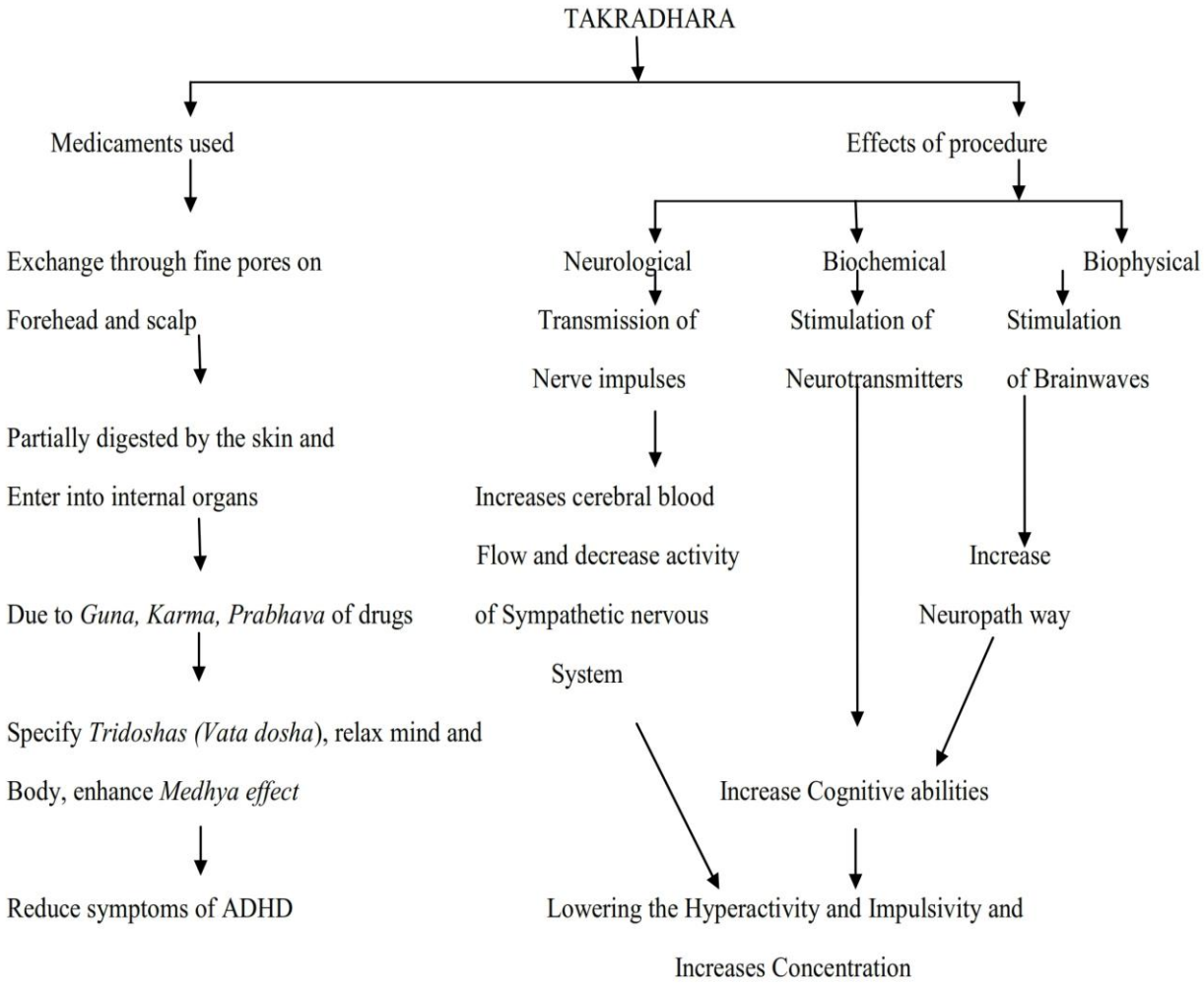

In a sample size of 40 patients 2 patients (5%) were shown Marked improvement, 28 patients (70%) showed Moderate improvement, 10 patients (10%) showed Mild improvement.

**Samprapthi bhedana** [6s]

The *Shirodhara* is effective in following two ways

1) Medicaments used and its therapeutic effect

2) Effect of the procedure




The *Shirodhara* is effective in following two ways

1) Medicaments used and its therapeutic effect

2) Effect of the procedure

1) Medicaments and its therapeutic effect

- The therapeutic effect is partially attributed to the medicaments viz. the medicated *taila, Ghrita, Takra, Kwatha* etc. Which are digested by the skin, enter into the internal organs through the orifices present in the skin similar to the fine effect obtained from the substances used in *Abhyanga, Snana, Udvartana* etc. The *Dosa* specific *dravyas* used in *Dhara* also help in pacifying all vitiated *Tridoshas* and reduce their effect on *Sharira* and *Manas.*

2) Basic effect of the procedure

- The procedure of *Shirodhara* itself seems to produce a relaxation response irrespective of the medicament used. When liquid is poured in an even stream on the forehead continuously diminishes the effects of stress and strain and relaxes the body and mind.

- With continuous flow of liquid over forehead in *Dhara* may stimulate important cortical functions and vital centers (responsible for impulsive behavior, judgment, language production, memory, and executive behavior etc.) which are located in the frontal lobe and prefrontal cortex of the head and thus may help in tackling with the core symptoms of ADHD.

- Brain waves generated by neurons are close to the brain surface, mainly in the cerebral cortex. Likewise these waves can be stimulated with the waves of opposite direction which are produced by the continuous stream of medicated liquid over forehead in *Takradhara*. Thus *Dhara* increase in brain wave activation which helps in neuropathway growth.

- The Skin on the forehead and scalp is also highly vascular thus external stimulus through *Takradhara* procedure would help to irrigate this area and also helps in increase of endorphin which help in production of neurotransmitters (Dopamine and Nor epinephrine), when these increase, there is increase in cognitive abilities, which are generally affected in ADHD.

- The important areas of the brain, centre for judgement, centre for intellect, centre for speech etc are situated in frontal area, with *Takradhara* relaxation of the frontalis muscle occurs, tends to normalize the activities of the entire body, improve cerebral functions through increased cerebral blood flow, enhances concentration abilities and decrease in activity of sympathetic nervous system thus lowering the hyperactivity and impulsive behavior found in ADHD children. Thus relaxing mind and body.

- *Shirodhara* may help to stimulate many vital areas like *Sthapani Marma* and *Agna Chakra*, which are seated in *Bhrumadhya* and are *sthana of Manas*.

Slight stimulation of these spots may have beneficial effect on the mind and body, due to their connection with higher centers. Such a vital area is selected for *Shirodhara.* Thus by continuous flow of *Dhara o*n forehead stimulates these points by which the stability of functions of the *Manas* might be gained and may be reason in reducing features of psychosomatic disorders like ADHD.

- Thus *Dhara* may help to promote relaxation of mind and body and it can be understood in the following ways –

    1) Neurological – Through transmission of nerve impulses
    2) Bio chemical – Stimulation of neurotransmitters
    3) Bio physical – Stimulation of brain waves

# SUMMARY

The present dissertation work entitled **AN EXPLORATORY STUDY OF MEDICATED TAKRADHARA IN THE MANAGEMENT OF ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)** consists of the following parts-

- Introduction
- Literary review
- Drug review
- Research methodology
- Clinical study
- Discussion
- Summary and Conclusion

**Introduction**

The importance of selection of disease ADHD in present era, need of understanding of the disease in *Ayurvedic* view and its *Ayurvedic* management is mentioned in the present study. It also includes plan of the study and it is mainly the protocol of the present research work.

**Literary review**

At first, Historical review deals with the evolution of the disease ADHD from the past era to the present era from modern sciences. A detailed conceptual review is described for better understanding of the concepts of *Manas* and that of the disease ADHD, a comprehensive description of *Mano Vyapara*, description of abnormal behavioral patterns in *Sharira* and *Manas Prakriti* in the context of ADHD. The co relation of disease ADHD which can be done with the various mental disorders in *Ayurveda.* Comparison of the concept of *Manas* with that of CNS especially cerebral cortex of brain and understanding of the disease ADHD in the light of *Ayurveda.*

**Drug review**

A detailed description of the drugs- *Brahmi, Jatamamsi, Vacha, Aswagandha* have been given along with the available clinical and pharmacological research work review.

Description of medicated *Takradhara,* and its properties.

**Research methodology**

Description of the materials used in the study and methods followed to conduct the present research work with the description of the assessment criteria, scoring, statistical test used for analysis

**Clinical study**

A total of 43 patients were registered in the study out of which 40 completed the treatment as per case Performa specially prepared for the study. The observations and results obtained from the study were statistically analyzed and presented in the form of tables and graphs.

**Discussion**

A detailed discussion regarding the importance and relevance of the concept of *Manas* in the context of ADHD is given. The observations and results of the clinical study was critically analyzed and rationalized to understand the truth about the efficacy of the management taken for the presented study.

**Summary and Conclusion**

The total research work is summarized and the appropriate conclusions were drawn from the present clinical study.

# CONCLUSION

1. ADHD is a neurobehavioral and psychological disorder commonly seen in school going children especially boys.
2. Early diagnosis of the disease ADHD is necessary for early intervention, safety treatment and guidance to the parents about children with ADHD.
3. Attention deficit hyperactivity disorder can be clearly understood in Ayurveda through basic knowledge of Manas and Manasika rogas.
4. Takradhara was found effective in ADHD children with no adverse effects.

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***ANNEXURE-1***

**CONSENT FORM AND CONFIDENTIALITY AGREEMENT**

I, …… hereby give my full consent on behalf of my child……. to be included in the clinical trial titled **An Exploratory study of Medicated Takradhara in the management of Attention Deficit Hyperactivity Disorder** conducted at S.V. Ayurvedic hospital, Tirupathi. I understand that my child may be treated for the disease he or she is suffering from. I have been informed to my satisfaction by the attending physician, the purpose of the clinical trial and the nature of the treatment and follow up. I am also aware of the right to opt out of the trial at any time during the course of trial without having the reason for doing so. I don't have any objection in incorporation of data derived out of my participation in the study to be presented as a scientific document/paper/thesis without disclosing my identity.

Signature of the PhD Scholar Signature / Thumb impression

Of Parent /Guardian

Place:

Date:

# "AN EXPLORATORY STUDY OF MEDICATED TAKRADHARA IN THE MANAGEMENT OF ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)"

## CASE PROFORMA

| | |
|---|---|
| **Name:** | **OPD No:** |
| **Age:** | **IPD No:** |
| **Sex:** | **Religion:** |
| **Address:** | **Caste:** |
| | **DOA:** |
| **Contact No:** | **DOD** |
| **Informant:** | **Socio-economic status:** |
| **Relation:** | |
| **Father's name:** | **Mother`s name:** |

---

**Chief complaint:**

**History of presenting complaint:**

Duration:

Symptom which prompted for medical advice:

Aggravating or relieving factors:

**H/o previous illness:**

**Associated disorders:**

**Diagnostic criteria**

| Sr. No | DSM-IV Items | Never 0 | Often 1 | Quite often 2 | Very often 3 |
|---|---|---|---|---|---|
| s(1) | **INATTENTION :** | | | | |
| | (a) Fails to give close attention to details or makes careless mistakes in school work, work or other activities | | | | |
| | (b) Difficulty in sustaining attention in tasks or play activities | | | | |
| | (c) Does not seem to listen when spoken to directly | | | | |
| | (d) Does not follow on instructions and fails to finish school work, chores or duties in the work place | | | | |
| | (e) Dislikes, avoids on is reluctant to engage in tasks that require sustained mental effort e.g. school work, homework. | | | | |
| | (f) Often looses things necessary for tasks or activities e.g. school assignments pencils books, etc. | | | | |
| | (g) Is often forgetful in daily activities. | | | | |
| | (i) Has difficulty organizing tasks and activities | | | | |
| (2) | **HYPERACTIVITY** | | | | |
| | (a) Fidgets with hands or feet or squirms in seat | | | | |
| | (b) Leaves slat in classroom or in other situations in which remaining seated is expected. | | | | |
| | (c) Runs about or climbs excessively in situations in which it is inappropriate. (in adolescents may be limited to subjective feeling of restlessness) | | | | |
| | (d) Has difficulty playing or engaging in leisure activities quietly. | | | | |
| | (e) "On the go" or acts as of "driven by a motor" | | | | |
| 3. | **IMPULSIVITY :** | | | | |
| | (g) Blurts out answers before questions have been completed | | | | |
| | (h) Has difficulty aviating turn | | | | |
| | (i) Interrupts in intrudes on others | | | | |

**Assessment scale for ADHD based on Conner's Parent Rating Scale (CRS-R)** Each items is to be rated by the parent on a four-part scale of "not at all", "just a little", "pretty much" or "very much" with scores of 0,1,2 and 3 for these respective response.

| Sl. No | Conner's Parent Rating Scale | Not at all<br>0 | Just a little<br>1 | Pretty much<br>2 | Very much<br>3 |
|---|---|---|---|---|---|
| 1. | Often fidgets or squirms in seat. | | | | |
| 2. | Has difficulty remaining seated | | | | |
| 3. | Is easily distracted | | | | |
| 4. | Has difficulty awaiting turn in groups | | | | |
| 5. | Often blurts out answers to questions | | | | |
| 6. | Has difficulty following instructions | | | | |
| 7. | Has difficulty sustaining attention to tasks | | | | |
| 8. | Often shifts from one uncompleted activity to another | | | | |
| 9. | Has difficulty playing quietly | | | | |
| 10. | Often talks excessively | | | | |
| 11. | Often interrupts or intrudes on others | | | | |
| 12. | Often does not seem to listen | | | | |
| 13. | Often loses things necessary for tasks | | | | |
| 14. | Often engages in physically dangerous activities without considering consequences | | | | |

Not at all: 0

Just a little: 1

Minimum score: 00

Pretty much: 2

Very much: 3

Maximum score: 42

**Family history:**

Parent's marriage history: Consanguineous / Non consanguineous

Type of family: Nuclear / joint

Family history of illness: Psychiatric illness / Medical illness /surgical illness

| | | | |
|---|---|---|---|
| Father's age | Education | Occupation | Habit |
| Mother's age | Education | Occupation | Habit |

**Sibling history:**

**Attitude of the parents towards the child:** Supportive /Abusive /Neglect / Over Stimulation / Over Protection / Intrusiveness / Lax Discipline / Inconsistent Discipline

Other Family Problems (Divorce, Violence) *Yes / No*

**Personal history:**

Diet: Vegetarian/ Non-Veg

Appetite: Good/ Moderate/ Poor

Bowels: Normal/ Constipated/ Loose Stools/ Undigested Food in Feces

Micturition: Normal/ Polyuria/ Anuria/ Dysuria/ Bedwetting

Sleep: Sound/ Disturbed/ Day sleep/ Night Wakening

Habits:

Foods Allergies if Any:

**Birth history:**

**Antenatal**: Uneventful / Fever / Pain Abdomen / Leaking Pv / Eclampsia / Pre Eclampsia / Infections / Hypertension / D.M / Hyper emesis / Bleeding / Others

Maternal Age:

Disease of the Mother with Medication:

Drug intake:

Iron Supplementation:

Psychological Stress:

**Natal history**

Delivery: Home / Hospital Normal / Cs /Forceps / Vacuum

Gestational Age: Full Term / Pre / Post

Fetal Distress: Prolonged Second Stage / Me conium Stained Amniotic Fluid / Others

Birth Weight:

Birth cry:

**Postnatal**

Sucking

H /O Neonatal Jaundice /Seizures / Cyanosis / RDS / Infection / Lethargy/ Mechanical insults to the Brain

Disease of the Child with Medication:

**Developmental history**

**Feeding History:**

Mode of Feeding: Breastfed / Bottle-fed

Feeding Problem: Vomiting / Diarrhea / Constipation

Weaning Age:

Self-Feeding:

**Developmental milestones**

**Gross Motor**

| | |
|---|---|
| Head Control | Sitting |
| Turning Over | Standing |
| Crawling | Walking |

**Fine Motor**

| | | |
|---|---|---|
| Grasping | Self Feeding | Buttoning |
| Drawing | | |

**Social**

Social Smile

Responds to Name

Dresses Unassisted

**Language**

Bisyllables/ Small Sentences

**Over all development of milestones**

Motor: Normal / Delayed

Fine Motor: Normal / Delayed

Social: Normal / Delayed

Language: Normal / Delayed

**Schooling History**

Age of Initiation:

Adjustment to Schools:

Change of School / Medium / Syllabus:

Scholastic Performance:

Peer Relation in School:

Participation in Extra Curricular Activities:

Learning Disorders: Reading / Writing / Arithmetic

Other School Problems:

Habits / Interests / and Talents

**Treatment history**

**Immunization history**

**General examination**

1) Appearance: Comfortable / Sick Looking/ Hyperactive / Inattentive

2) Built: Poor/ Moderate/ Well

3) Nourishment: Poor/ Moderate/ Well

4) Face: Normal / Puffiness /Orbital Swelling

5) Vital Signs: Temperature: Pulse Rate: Respiratory:

**Systemic examination**

**Respiratory system** Rate: Rhythm:

Character of Breathing: Thoracic Abdominal / Thoracic / Abdominal

**Cardio vascular system:**

Heart Rate Heart Sounds

**Gastro intestinal system:**

**Urogenital system:**

**Central nervous system:**

**Higher Mental Function**

| | | | |
|---|---|---|---|
| Appearance: | Hallucination: | Behavior: | Intelligence: |
| Consciousness: | Memory: | Delusions: | Orientation |
| Emotions: | Sleep: | Speech: | |

**Motor**

Bulk:

Tone:

Power:

Gait:

Co-Ordination of Movements:

Reflexes:

**Sensory Cranial nerves**

**Ayurvedic Asta sthana pariksha**

Nadi :

Malam :

Mutram :

Sabda :

Sparsa :

Rupa :

Drik :

Jihwa :

**Dasa vidha pariksha**

1. Prakritah
2. Vikritita
3. Saratah
4. Satvata
5. Samhanatha
6. Satmyata
7. Pramanatah
8. Abhyavaharana sakti
9. Vyayama sakti
10. Vayah

**Assesment of sarira and manasa doshas**

| **Rajasika** | **Tamasika** |
|---|---|
| Dukha Bahulata | Visaditvam |
| Atanasilata | Nastikyam |
| Adhrti | Adharmasilata |
| Ahankara | Buddheh Nirodhah |
| Anrtikatvam | Ajnanam |
| Akarunyam | Durmedastvam |
| Dambha | Akarmasilata |
| Mana | Nidralutvam |
| Harsha | |
| Kama | |
| Krodha | |

**Treatment advised** : Takradhara – 14days

**Scoring and Follow up will be taken accordingly based on diagnostic criteria**

| **Before treatment** | **After 1st sitting** | **After 2nd sitting** | **After treatment** | **After follow up** |
|---|---|---|---|---|
| | | | | |

Signature of PhD scholar Signature of Guide

**Master chart- Observations**

| | | | | Status of child in school | | | Positive Birth History | | | | Developmental History | | | Sleep | Subtype of ADHD | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of pts. | Age (years) | Sex | Family history of Psychological illness | Poor scholastic performance | Poor adjustment to school | Poor peer relations | Eventful Antenatal History | Low Birth Weight | Preterm | Neonatal Illness | Nothing specific | Normal | Abnormal | Disturbed | ADHD-HI | ADHD- I | ADHD-C |
| 1 | 7 | M | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 2 | 9 | M | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 3 | 8 | M | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 4 | 11 | M | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 5 | 10 | M | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 6 | 8 | M | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 7 | 7 | M | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 8 | 9 | M | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 9 | 9 | M | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 10 | 11 | F | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 11 | 12 | F | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 12 | 7 | M | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| 13 | 8 | M | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 |
| 14 | 8 | M | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 15 | 11 | M | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 16 | 12 | M | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| 17 | 10 | F | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 18 | 10 | M | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 19 | 9 | M | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 20 | 12 | M | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 21 | 7 | M | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 22 | 8 | M | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| 23 | 10 | M | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 24 | 9 | M | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| 25 | 11 | F | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 26 | 11 | M | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 27 | 10 | M | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 28 | 11 | F | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 29 | 12 | M | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 30 | 7 | M | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 31 | 9 | F | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 32 | 10 | M | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| 33 | 8 | M | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 34 | 8 | M | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 35 | 9 | M | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 36 | 7 | M | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| 37 | 10 | M | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 38 | 12 | M | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 39 | 10 | M | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 40 | 11 | M | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |

0= Negative
1= Positive

**Master Chart**

| DSM IV | Fail to give details | | Difficulty in sustaining attention | | Not seem to listen | | Fails to follow instructions and finish work | | Difficulty in organizing tasks | | Dislikes, avoids or is reluctant to engage in tasks | | Often looses things | | Often easily distracted | | often forgetful | | Often fidgets | | Often leaves seat in classroom | | Often runs about or climbs | | Often has difficulty in playing | | Often "on the go" or acts as of "driven by the motor" | | Often talks excessively | | Often blurts out answers before questions | | has difficulty in awaiting turn | | Often interrupts or intrudes on others | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| no. of pts | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt sum | at sum | bt-at | % |
| 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 50 | 15 | 35 | 70 |
| 2 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 1 | 0 | 49 | 16 | 33 | 67.34693878 |
| 3 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 50 | 15 | 35 | 70 |
| 4 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 2 | 0 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 1 | 44 | 15 | 29 | 65.90909091 |
| 5 | 3 | 1 | 2 | 0 | 3 | 2 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 2 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 49 | 18 | 31 | 63.26530612 |
| 6 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 47 | 16 | 31 | 65.95744681 |
| 7 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 51 | 18 | 33 | 64.70588235 |
| 8 | 3 | 1 | 2 | 1 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 0 | 2 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 0 | 2 | 0 | 2 | 1 | 2 | 0 | 2 | 1 | 2 | 1 | 46 | 17 | 29 | 63.04347826 |
| 9 | 2 | 0 | 3 | 2 | 2 | 1 | 3 | 2 | 3 | 1 | 2 | 0 | 2 | 1 | 3 | 1 | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 0 | 2 | 1 | 2 | 0 | 3 | 1 | 2 | 0 | 2 | 1 | 44 | 16 | 28 | 63.63636364 |
| 10 | 3 | 1 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 0 | 2 | 0 | 3 | 2 | 3 | 2 | 3 | 0 | 3 | 0 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 48 | 18 | 30 | 62.5 |
| 11 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 0 | 2 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 3 | 0 | 3 | 1 | 3 | 1 | 47 | 12 | 35 | 74.46808511 |
| 12 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 48 | 15 | 33 | 68.75 |
| 13 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 2 | 0 | 49 | 15 | 34 | 69.3877551 |
| 14 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 0 | 3 | 0 | 3 | 1 | 2 | 1 | 3 | 0 | 3 | 0 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 0 | 2 | 1 | 1 | 0 | 45 | 11 | 34 | 75.55555556 |
| 15 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 2 | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 48 | 21 | 27 | 56.25 |
| 16 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 47 | 13 | 34 | 72.34042553 |
| 17 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 0 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 47 | 14 | 33 | 70.21276596 |
| 18 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 50 | 16 | 34 | 68 |
| 19 | 3 | 1 | 2 | 1 | 3 | 2 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 0 | 3 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 0 | 3 | 1 | 50 | 16 | 34 | 68 |
| 20 | 2 | 0 | 3 | 1 | 2 | 1 | 3 | 2 | 3 | 1 | 2 | 0 | 2 | 0 | 3 | 0 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 0 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 43 | 14 | 29 | 67.44186047 |
| 21 | 3 | 1 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 2 | 1 | 45 | 18 | 27 | 60 |
| 22 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 51 | 22 | 29 | 56.8627451 |

**Master Chart**

| DSM IV | Fail to give details | | Difficulty in sustaining attention | | Not seem to listen | | Fails to follow instructions and finish work | | Difficulty in organizing tasks | | Dislikes, avoids or is reluctant to engage in tasks | | Often looses things | | Often easily distracted | | often forgetful | | Often fidgets | | Often leaves seat in classroom | | Often runs about or climbs | | Often has difficulty in playing | | Often "on the go" or acts as of "driven by the motor" | | Often talks excessively | | Often blurts out answers before questions | | has difficulty in awaiting turn | | Often interrupts or intrudes on others | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| no. of pts | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt sum | at sum | bt-at | % |
| 23 | 3 | 2 | 3 | 2 | 2 | 0 | 2 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 2 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 50 | 19 | 31 | 62 |
| 24 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 2 | 0 | 2 | 0 | 3 | 1 | 44 | 14 | 30 | 68.18181818 |
| 25 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 52 | 18 | 34 | 65.38461538 |
| 26 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 1 | 3 | 0 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 0 | 3 | 1 | 3 | 0 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 2 | 1 | 46 | 12 | 34 | 73.91304348 |
| 27 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 0 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 1 | 2 | 1 | 46 | 14 | 32 | 69.56521739 |
| 28 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 3 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 1 | 0 | 43 | 14 | 29 | 67.44186047 |
| 29 | 2 | 0 | 2 | 1 | 3 | 1 | 3 | 2 | 2 | 1 | 2 | 0 | 3 | 1 | 3 | 2 | 3 | 1 | 2 | 1 | 2 | 0 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 46 | 15 | 31 | 67.39130435 |
| 30 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 50 | 17 | 33 | 66 |
| 31 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 0 | 3 | 2 | 2 | 0 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 49 | 18 | 31 | 63.26530612 |
| 32 | 3 | 2 | 2 | 1 | 3 | 2 | 2 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 2 | 2 | 0 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 0 | 45 | 17 | 28 | 62.22222222 |
| 33 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 51 | 18 | 33 | 64.70588235 |
| 34 | 3 | 2 | 2 | 0 | 3 | 2 | 2 | 1 | 2 | 1 | 3 | 2 | 3 | 1 | 2 | 1 | 2 | 0 | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 1 | 45 | 19 | 26 | 57.77777778 |
| 35 | 3 | 2 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 0 | 3 | 2 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 0 | 3 | 1 | 2 | 1 | 51 | 19 | 32 | 62.74509804 |
| 36 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 51 | 19 | 32 | 62.74509804 |
| 37 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 2 | 2 | 0 | 2 | 1 | 2 | 0 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 47 | 16 | 31 | 65.95744681 |
| 38 | 3 | 1 | 3 | 2 | 2 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 2 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 0 | 2 | 1 | 3 | 1 | 49 | 20 | 29 | 59.18367347 |
| 39 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 48 | 16 | 32 | 66.66666667 |
| 40 | 3 | 1 | 3 | 2 | 3 | 2 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 2 | 2 | 2 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 1 | 0 | 3 | 1 | 2 | 0 | 46 | 19 | 27 | 58.69565217 |

**Master chart - Conner's parent rating scale**

| NO. of pts | Often fidgets or squirms | | Has difficulty remaining seated | | Easily distracted | | Has difficulty awaiting turn in groups | | Often blurts out answers | | Has difficulty following instructions | | Has difficulty sustaining attention to tasks | | Often shifts from one uncompleted activity to another | | Often has difficulty playing quietly | | Often talks excessively | | Often interrupts or intrudes on others | | Often does not seem to listen | | Looses things necessary for tasks | | Engages in physically dangerous activities | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt | at | bt sum | at sum | bt-at | % |
| 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 2 | 0 | 3 | 1 | 37 | 12 | 25 | 67.56756757 |
| 2 | 3 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 34 | 12 | 22 | 64.70588235 |
| 3 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 36 | 12 | 24 | 66.66666667 |
| 4 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 0 | 1 | 0 | 34 | 9 | 25 | 73.52941176 |
| 5 | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 2 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 2 | 1 | 37 | 15 | 22 | 59.45945946 |
| 6 | 3 | 1 | 3 | 1 | 2 | 1 | 1 | 0 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 0 | 35 | 11 | 24 | 68.57142857 |
| 7 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 40 | 14 | 26 | 65 |
| 8 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 3 | 2 | 2 | 1 | 3 | 1 | 3 | 0 | 2 | 1 | 1 | 0 | 3 | 2 | 3 | 1 | 3 | 1 | 36 | 13 | 23 | 63.88888889 |
| 9 | 1 | 0 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 2 | 3 | 2 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 33 | 14 | 19 | 57.57575758 |
| 10 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 2 | 3 | 2 | 2 | 1 | 2 | 1 | 2 | 0 | 3 | 2 | 3 | 1 | 2 | 0 | 24 | 15 | 9 | 37.5 |
| 11 | 2 | 0 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 35 | 10 | 25 | 71.42857143 |
| 12 | 3 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 2 | 37 | 13 | 24 | 64.86486486 |
| 13 | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 34 | 13 | 21 | 61.76470588 |
| 14 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 35 | 12 | 23 | 65.71428571 |
| 15 | 1 | 0 | 2 | 0 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 2 | 1 | 33 | 14 | 19 | 57.57575758 |
| 16 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 37 | 11 | 26 | 70.27027027 |
| 17 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 36 | 12 | 24 | 66.66666667 |
| 18 | 2 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 2 | 1 | 3 | 1 | 3 | 1 | 35 | 12 | 23 | 65.71428571 |
| 19 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 37 | 14 | 23 | 62.16216216 |
| 20 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 2 | 0 | 2 | 1 | 2 | 1 | 2 | 1 | 34 | 13 | 21 | 61.76470588 |
| 21 | 3 | 0 | 2 | 0 | 3 | 1 | 1 | 0 | 2 | 1 | 3 | 1 | 3 | 2 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 35 | 12 | 23 | 65.71428571 |
| 22 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 2 | 3 | 1 | 3 | 1 | 40 | 14 | 26 | 65 |
| 23 | 1 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 3 | 1 | 2 | 1 | 24 | 13 | 11 | 45.83333333 |
| 24 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 36 | 11 | 25 | 69.44444444 |
| 25 | 2 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 38 | 13 | 25 | 65.78947368 |
| 26 | 3 | 2 | 3 | 1 | 2 | 0 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 0 | 1 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 34 | 12 | 22 | 64.70588235 |
| 27 | 1 | 0 | 2 | 0 | 2 | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 34 | 10 | 24 | 70.58823529 |
| 28 | 3 | 1 | 3 | 1 | 2 | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 1 | 0 | 2 | 1 | 2 | 0 | 2 | 0 | 32 | 10 | 22 | 68.75 |
| 29 | 2 | 1 | 2 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 36 | 13 | 23 | 63.88888889 |
| 30 | 1 | 0 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 37 | 13 | 24 | 64.86486486 |
| 31 | 2 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 0 | 2 | 1 | 35 | 11 | 24 | 68.57142857 |
| 32 | 3 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 2 | 3 | 1 | 1 | 0 | 33 | 14 | 19 | 57.57575758 |
| 33 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 2 | 0 | 36 | 11 | 25 | 69.44444444 |
| 34 | 3 | 1 | 2 | 1 | 2 | 1 | 1 | 0 | 2 | 0 | 2 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 1 | 0 | 3 | 2 | 3 | 1 | 3 | 1 | 32 | 12 | 20 | 62.5 |
| 35 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 3 | 2 | 3 | 1 | 2 | 0 | 37 | 13 | 24 | 64.86486486 |
| 36 | 1 | 0 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 36 | 13 | 23 | 63.88888889 |
| 37 | 3 | 1 | 3 | 1 | 2 | 0 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 1 | 3 | 1 | 38 | 12 | 26 | 68.42105263 |
| 38 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 1 | 3 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 38 | 14 | 24 | 63.15789474 |
| 39 | 2 | 1 | 3 | 1 | 3 | 1 | 1 | 0 | 2 | 1 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 0 | 3 | 1 | 2 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 34 | 11 | 23 | 67.64705882 |
| 40 | 3 | 1 | 2 | 1 | 2 | 0 | 3 | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 2 | 0 | 3 | 1 | 2 | 1 | 1 | 0 | 3 | 2 | 3 | 1 | 1 | 0 | 32 | 10 | 22 | 68.75 |