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ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD): AN OVERVIEW

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ABSTRACT: Attention deficit hyperactivity disorder (ADHD) is a developmental disorder. It is a chronic condition that affects millions of children and often persists into adulthood. ADHD is the most commonly studied and diagnosed psychiatric disorder in children. ADHD includes some combination of problems, such as difficulty sustaining attention, hyperactivity and impulsive behavior. Children with ADHD also may struggle with low self-esteem, troubled relationships and poor performance in school. Adolescents and adults with ADHD tend to develop coping mechanisms to compensate for some or all of their impairments. Although much progress has been made in our understanding of the diagnosis and treatment of ADHD, much has yet to be researched, particularly for adolescents. It is clear that the current diagnostic criteria, although valid for children, may need to be modified for adolescents and adults, to reflect the developmental changes that take place as children approach adulthood. Studies are required to clarify how medication needs, types, dosages, and frequencies of administration differ among adolescents and adults, compared with children.

INTRODUCTION: Attention deficit hyperactivity disorder (ADHD) is a developmental disorder. It is characterized primarily by "the co-existence of attentional problems and hyperactivity, with each behavior occurring infrequently alone" and symptoms starting before seven years of age.

ADHD is the most commonly studied and diagnosed psychiatric disorder in children, affecting about 3 to 5 percent of children globally and diagnosed in about 2 to 16 percent of school-aged children. It is a chronic condition that affects millions of children and often persists into adulthood.

ADHD includes some combination of problems, such as difficulty sustaining attention, hyperactivity and impulsive behavior. Children with ADHD also may struggle with low self-esteem, troubled relationships and poor performance in school¹.

It is a chronic disorder with 30 to 50 percent of those individuals diagnosed in childhood continuing to have symptoms into adulthood. Adolescents and adults with ADHD tend to develop coping mechanisms to compensate for some or all of their impairments.

It is estimated that 4.7 percent of American adults live with ADHD. Standardized rating scales such as the World Health Organization's Adult ADHD Self-Report Scale can be used for ADHD screening and assessment of the disorder's symptoms' severity.



It means that in any given classroom with an average size (between 25 and 30 children), there is likely to be at least one child who has ADHD, whether he or she has been diagnosed with the disorder or not. It also means that a business employing 50 people will also have one or two ADHD sufferers².

ADHD is diagnosed two to four times more frequently in boys than in girls, though studies suggest this discrepancy may be partially due to subjective bias of referring teachers. ADHD management usually involves some combination of medications, behavior modifications, lifestyle changes, and counseling. Its symptoms can be difficult to differentiate from other disorders, increasing the likelihood that the diagnosis of ADHD will be missed. In addition, most clinicians have not received formal training in the assessment and treatment of ADHD, in particular in adult patients.

ADHD and its diagnosis and treatment have been considered controversial since the 1970s. The controversies have involved clinicians, teachers, policymakers, parents and the media. Topics include ADHD's causes, and the use of stimulant medications in its treatment. Most healthcare providers accept that ADHD is a genuine disorder with debate in the scientific community centering mainly on how it is diagnosed and treated. The American Medical Association concluded in 1998 that the diagnostic criteria for ADHD are based on extensive research and, if applied appropriately, lead to the diagnosis with high reliability.

The Attention Deficit Disorder exists for most people. Everybody has some of these symptoms some of the time.

However, individuals with ADHD have more of these symptoms, more of the time and to the point that it interferes with their ability to function normally at school, work and social settings. It can also limit their full potential.

ADHD people, those under the definition of ADHD, are often noted for their inconsistencies. One day they can "do it," and the next they can't. They may have difficulty remembering simple things yet have "steel trap" memories for complex issues. To avoid disappointment, frustration and discouragement don't expect their highest level of competence to be the standard.

It's an unrealistic expectation of a person with attention deficit disorder. The ADHD will be inconsistent.

Typically, they have problems with following through on instructions, paying attention appropriately to what they need to attend to, seem not to listen, be disorganized, have poor handwriting, miss details, have trouble starting tasks or with tasks that require planning or long-term effort, appear to be easily distracted, or forgetful.³

In addition, some people with ADHD can be fidgety, verbally impulsive, and unable to wait their turn, and act on impulse regardless of consequences.

But, not all people with ADHD have all of these difficulties, nor all of the time. Because society has traditionally thought of a person with attention deficit disorder as being "hyper," many sufferers of have ADHD with no hyperactivity are not being identified or treated. Individuals with ADHD without hyperactivity are sometimes thought of as day-dreamers or "absent-minded professors".

The non-hyperactive ADHD patients most often seem to be females though females can have attention deficit disorder with hyperactivity, and males can have ADHD without hyperactivity.

Additionally, because of the ability of an individual with ADHD to over-focus, or "hyper-focus" on something that is of great interest or highly stimulating, many untrained observers assume that this ability to concentrate negates the possibility of attention deficit disorder being a concern.

Especially when they see children able to pay attention while working individually with someone, doing something they enjoy, or who can sit and play an electronic game or watch TV for hours on end.

ADHD is not a learning disability. Although ADHD obviously effects the performance of a person in a school setting, it will also affect other domains of life, which can include relationships with others, running a home, keeping track of finances, and organizing, planning, and managing most areas of one's life. According to the definition of ADHD, all children are sometimes restless, sometimes act without thinking, and sometimes daydream the time away.

When the child's hyperactivity, distractibility, poor concentration, or impulsivity begin to affect performance in school, social relationships with other children, or behavior at home, the definition of ADHD and may be suspected ⁴.

Classification: ADHD may be seen as one or more continuous traits found normally throughout the general population. It is a developmental disorder in which certain traits such as impulse control lag in development. Using magnetic resonance imaging of the prefrontal cortex, this developmental lag has been estimated to range from 3 to 5 years. However, the definition of ADHD is based on behaviour and it does not imply a neurological disease. ADHD is classified as a disruptive behavior disorder along with oppositional defiant disorder, conduct disorder and antisocial personality disorder.

ADHD has three subtypes:

1. Predominantly hyperactive-impulsive

- a. Most symptoms (six or more) are in the hyperactivity-impulsivity categories.
- b. Fewer than six symptoms of inattention are present, although inattention may still be present to some degree.

2. Predominantly inattentive

- a. The majority of symptoms (six or more) are in the inattention category and fewer than six symptoms of hyperactivity-impulsivity are present, although hyperactivity-impulsivity may still be present to some degree.
- b. Children with this subtype are less likely to act out or have difficulties getting along with other children. They may sit quietly, but they are not paying attention to what they are doing. Therefore, the child may be overlooked, and parents and teachers may not notice symptoms of ADHD.

3. Combined hyperactive-impulsive and inattentive

- a. Six or more symptoms of inattention and six or more symptoms of hyperactivity-impulsivity are present.

- b. Most children with ADHD have the combined type.⁵

Signs and Symptoms: Inattention, hyperactivity, and impulsivity are the key behaviors of ADHD. The symptoms of ADHD are especially difficult to define because it is hard to draw the line at where normal levels of inattention, hyperactivity, and impulsivity end and clinically significant levels requiring intervention begin. To be diagnosed with ADHD, symptoms must be observed in two different settings for six months or more and to a degree that is greater than other children of the same age ⁶.

The symptom categories of ADHD in children yield three potential classifications of ADHD, predominantly inattentive type, predominantly hyperactive-impulsive type, or combined type if criteria for both subtypes are met:

Predominantly inattentive type symptoms may include:

- Be easily distracted, miss details, forget things, and frequently switch from one activity to another
- Have difficulty maintaining focus on one task
- Become bored with a task after only a few minutes, unless doing something enjoyable
- Have difficulty focusing attention on organizing and completing a task or learning something new or trouble completing or turning in homework assignments, often losing things (e.g., pencils, toys, assignments) needed to complete tasks or activities
- Not seem to listen when spoken to
- Daydream, become easily confused, and move slowly
- Have difficulty processing information as quickly and accurately as others
- Struggle to follow instructions ⁷.

Predominantly hyperactive-impulsive type symptoms may include:

- Fidget and squirm in their seats

- Talk nonstop
- Dash around, touching or playing with anything and everything in sight
- Have trouble sitting still during dinner, school, and story time
- Be constantly in motion
- Have difficulty doing quiet tasks or activities, and also these manifestations primarily of impulsivity:
- Be very impatient
- Blurt out inappropriate comments, show their emotions without restraint, and act without regard for consequences
- Have difficulty waiting for things they want or waiting their turns in games⁸.

Most people exhibit some of these behaviors, but not to the degree where such behaviors significantly interfere with a person's work, relationships, or studies, and in the absence of significant interference or impairment, a diagnosis of ADHD is normally not appropriate. The core impairments are consistent even in different cultural contexts.

Symptoms may persist into adulthood for up to half of children diagnosed with ADHD. This rate is difficult to estimate, as there are no official diagnostic criteria for ADHD in adults. ADHD in adults remains a clinical diagnosis. The signs and symptoms may differ from those during childhood and adolescence due to the adaptive processes and avoidance mechanisms learned during the process of socialization⁹. Other symptoms that ADHD include problems for effected people with social skills, motor difficulties; ADHD people also tend to have poorer handwriting compared to their peers. A 2009 study found that children with ADHD move around a lot because it helps them stay alert enough to complete challenging tasks¹⁰.

Comorbid Disorders: Inattention and "hyperactive" behavior are not necessarily the only problems in children with ADHD. ADHD exists alone in only about 1/3 of the children diagnosed with it. The combination of ADHD with other conditions can greatly complicate diagnosis and treatment.

Many co-existing conditions require other courses of treatment and should be diagnosed separately instead of being grouped in the ADHD diagnosis. There is a strong association between persistent bed wetting and ADHD as well as dyspraxia with up to 50 percent of dyspraxics having ADHD. Multiple research studies have also found a significant association between ADHD and language delay. Anxiety and depression are some of the disorders that can accompany ADHD.

Academic studies and research in private practice suggest that depression in ADHD appears to be increasingly prevalent in children as they get older, with a higher rate of increase in girls than in boys, and to vary in prevalence with the subtype of ADHD. Where a mood disorder complicates ADHD, it would be prudent to treat the mood disorder first, but parents of children with ADHD often wish to have the ADHD treated first, because the response to treatment is quicker.

Some of the associated conditions are:

- Oppositional defiant disorder and conduct disorder, which occur with ADHD at a rate of 50 percent and 20 percent respectively, are characterized by antisocial behaviors such as stubbornness, aggression, frequent temper tantrums, deceitfulness, lying, or stealing, inevitably linking these comorbid disorders with antisocial personality disorder (ASPD); about half of those with hyperactivity and ODD or CD develop ASPD in adulthood. However, modern brain imaging technology indicates that conduct disorder and ADHD are two distinct conditions.
- Borderline personality disorder, which was according to a study on 120 female psychiatric patients diagnosed and treated for BPD associated with ADHD in 70 percent of those cases.
- Primary disorder of vigilance, which is characterized by poor attention and concentration, as well as difficulties staying awake. These children tend to fidget, yawn and stretch and appear to be hyperactive in order to remain alert and active.

- Mood disorders. Boys diagnosed with the combined subtype have been shown likely to suffer from a mood disorder.
- Bipolar disorder. Adults with ADHD sometimes have co-morbid bipolar disorder, which requires careful assessment in order to accurately diagnose and treat both conditions.
- Anxiety disorder, which has been found to be common in girls diagnosed with the inattentive subtype of ADHD.
- Obsessive-compulsive disorder. OCD can co-occur with ADHD and shares many of its characteristics.

In Adults: Researchers found that 60 percent of the children diagnosed with ADHD continue having symptoms well into adulthood. Many adults, however, remain untreated. Untreated adults with ADHD often have chaotic lifestyles, may appear to be disorganized and may rely on non-prescribed drugs and alcohol to get by. They often have such associated psychiatric comorbidities as depression, anxiety disorder, substance abuse, or a learning disability.

A diagnosis of ADHD may offer adults insight into their behaviors and allow patients to become more aware and seek help with coping and treatment strategies. Recognized as occurring in adults in 1978, it is currently not addressed separately from ADHD in childhood. Obstacles that clinicians face when assessing adults who may have ADHD include developmentally inappropriate diagnostic criteria, age-related changes, comorbidities and the possibility that high intelligence or situational factors can mask ADHD.

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CAUSES: The specific causes of ADHD are not known. There are, however, a number of factors that may contribute to, or exacerbate ADHD. They include genetics, diet and the social and physical environments.

1. **Genetics:** Twin studies indicate that the disorder is highly heritable and that genetics are a factor in about 75 percent of all cases. Hyperactivity also seems to be primarily a genetic condition; however, other causes have been identified.

Researchers believe that a large majority of ADHD cases arise from a combination of various genes, many of which affect dopamine transporters. Candidate genes include $\alpha 2A$ adrenergic receptor, dopamine transporter,

dopamine receptors D2/D3, dopamine beta-hydroxylase monoamine oxidase A, catecholamine-methyl transferase, serotonin transporter promoter (SLC6A4), 5HT2A receptor, 5HT1B receptor, the 10-repeat allele of the DAT1 gene, the 7-repeat allele of the DRD4 gene,] and the dopamine beta hydroxylase gene (DBH TaqI). A common variant of a gene called LPHN3 is estimated to be responsible for about 9% of the incidence of ADHD, and ADHD cases where this gene is present are particularly responsive to stimulant medication¹².

2. **Evolution:** As ADHD is more common than 1 percent of the population, researchers have proposed that due to the high prevalence of ADHD that natural selection has favoured ADHD possibly because the individual traits may be beneficial on their own, and only become dysfunctional when these traits combine to form ADHD. The high prevalence of ADHD may in part be because women in general are more attracted to males who are risk takers, thereby promoting ADHD in the gene pool. Further evidence showing hyperactivity may be evolutionarily beneficial was put forth in 2006 in a study that found it may carry specific benefits for certain forms of society. In these societies, those with ADHD are hypothesized to have been more proficient in tasks involving risk, competition, and/or unpredictable behavior (i.e. exploring new areas, finding new food sources, etc.), where these societies may have benefited from confining impulsive or unpredictable behavior to a small subgroup. In these situations, ADHD would have been beneficial to society as a whole even while severely detrimental to the individual. More recent research suggests that because ADHD is more common in mothers who are anxious or stressed that ADHD is a mechanism of priming the child with the necessary traits for a stressful or dangerous environment, such as increased impulsivity and explorative behaviour etc. A genetic variant associated with ADHD (DRD4 48bp VNTR 7R allele) has been found to be at higher frequency in more nomadic populations and those with more of a history of migration. Consistent with this, another group of researchers observed that the health status of nomadic Ariaal men was

higher if they had the ADHD associated genetic variant (7R alleles). However in recently sedentary (non-nomadic) Ariaal those with 7R alleles seemed to have slightly worse health.

3. **Environmental:** Twin studies to date have suggested that approximately 9 to 20 percent of the variance in hyperactive-impulsive-inattentive behavior or ADHD symptoms can be attributed to nonshared environmental (nongenetic) factors. Environmental factors implicated include alcohol and tobacco smoke exposure during pregnancy and environmental exposure to lead in very early life. The relation of smoking to ADHD could be due to nicotine causing hypoxia (lack of oxygen) to the fetus in utero. It could also be that women with ADHD are more likely to smoke and therefore, due to the strong genetic component of ADHD, are more likely to have children with ADHD.

Complications during pregnancy and birth, including premature birth, might also play a role. ADHD patients have been observed to have higher than average rates of head injuries; however, current evidence does not indicate that head injuries are the cause of ADHD in the patients observed. Infections during pregnancy, at birth, and in early childhood are linked to an increased risk of developing ADHD. These include various viruses (measles, varicella, rubella, enterovirus) and streptococcal bacterial infection.

A 2007 study linked the organophosphate insecticide chlorpyrifos, which is used on some fruits and vegetables, with delays in learning rates, reduced physical coordination, and behavioral problems in children, especially ADHD. A 2010 study found that pesticide exposure is strongly associated with an increased risk of ADHD in children. Researchers analyzed the levels of organophosphate residues in the urine of more than 1,100 children aged 8 to 15 years old, and found that those with the highest levels of dialkyl phosphates, which are the breakdown products of organophosphate pesticides, also had the highest incidence of ADHD. Overall, they found a 35 percent increase in the odds of developing ADHD with every 10-fold increase in urinary concentration of the pesticide residues.

The effect was seen even at the low end of exposure: children who had any detectable, above-average level of pesticide metabolite in their urine were twice as likely as those with undetectable levels to record symptoms of ADHD. Three government-funded longitudinal studies from 2010 and 2011 examined environmental exposure to organophosphate pesticides between pregnancy and grade school.

Although the studies varied in techniques to measure pesticide exposure, they reached similar conclusions. Children exposed to higher levels of organophosphates during pregnancy were more likely to have lower IQs and problems focusing or solving problems. One study suggested that genetics play a strong role in whether exposure to organophosphates causes damage. Two studies found higher rates of ADHD diagnosis among children exposed to higher levels of organophosphate pesticides¹⁴.

4. **Diet:** A study published in *The Lancet* in 2007 found a link between children's ingestion of many commonly used artificial food colors, the preservative sodium benzoate and hyperactivity. In response to these findings, the British government took prompt action. According to the Food Standards Agency, the food regulatory agency in the UK, food manufacturers are being encouraged to voluntarily phase out the use of most artificial food colors by the end of 2009. Following the FSA's actions, the European Commission ruled that any food products containing the "Southampton Six" (The contentious colourings are: sunset yellow FCF (E110), quinoline yellow (E104), carmoisine (E122), allura red (E129), tartrazine (E102) and ponceau 4R (E124)) must display warning labels on their packaging by 2010.

In the US, the existing US Food Drug and Cosmetic Act had already required that artificial food colors be approved for use, that they must be given FD&C numbers by the FDA, and the use of these colors must be indicated on the package. This is why food packaging in the USA may state something like: "Contains FD&C Red #40." As of March 2011, the FDA was evaluating the scientific evidence of a link between dyes and ADHD; a preliminary analysis found there was no link¹⁵.

5. **Social:** The World Health Organization states that the diagnosis of ADHD can represent family dysfunction or inadequacies in the educational system rather than individual psychopathology. Other researchers believe that relationships with caregivers have a profound effect on attentional and self-regulatory abilities. A study of foster children found that a high number of them had symptoms closely resembling ADHD.

Researchers have found behavior typical of ADHD in children who have suffered violence and emotional abuse. Furthermore, Complex Post Traumatic Stress Disorder can result in attention problems that can look like ADHD. ADHD is also considered to be related to sensory integration dysfunction.

A 2010 article by CNN suggests that there is an increased risk for internationally adopted children to develop mental health disorders, such as ADHD and ODD. The risk may be related to the length of time the children spent in an orphanage, especially if they were neglected or abused. Many of these families who adopted the affected children feel overwhelmed and frustrated, since managing their children may entail more responsibilities than originally anticipated.

6. **Neurodiversity:** Proponents of the neurodiversity theory assert that atypical (neurodivergent) neurological development is a normal human difference that is to be tolerated and respected just like any other human difference. Social critics argue that while biological factors may play a large role in difficulties with sitting still in class and/or concentrating on schoolwork in some children, these children could have failed to integrate others' social expectations of their behavior for a variety of other reasons.

As genetic research into ADHD proceeds, it may become possible to integrate this information with the neurobiology in order to distinguish disability from varieties of normal or even exceptional functioning in people along the same spectrum of attention differences.

Social Construct Theory of ADHD: Social construction theory states that it is societies that determine where the line between normal and abnormal behavior is drawn. Thus society members including physicians, parents, teachers, and others are the ones who determine which diagnostic criteria are applied and, thus, determine the number of people affected. This is exemplified in the fact that the DSM IV arrives at levels of ADHD three to four times higher than those obtained with use of the ICD 10. Thomas Szasz, a proponent of this theory, has argued that ADHD was "invented and not discovered."

Low Arousal Theory: According to the low arousal theory, people with ADHD need excessive activity as self-stimulation because of their state of abnormally low arousal. The theory states that those with ADHD cannot self-moderate, and their attention can be gained only by means of environmental stimuli, which in turn results in disruption of attentional capacity and an increase in hyperactive behaviour.

Without enough stimulation coming from the environment, an ADHD child will create it him or herself by walking around, fidgeting, talking, etc. This theory also explains why stimulant medications have high success rates and can induce a calming effect at therapeutic dosages among children with ADHD. It establishes a strong link with scientific data that ADHD is connected to abnormalities with the neurochemical dopamine and a powerful link with low-stimulation PET scan results in ADHD subjects¹⁶.

Pathophysiology

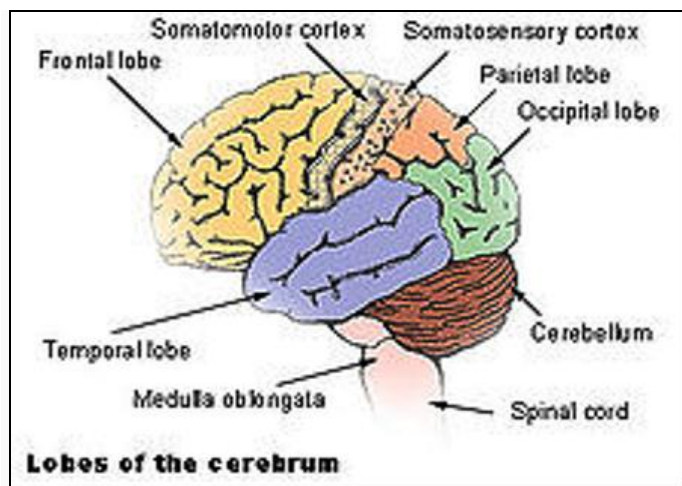


DIAGRAM OF THE HUMAN BRAIN

The pathophysiology of ADHD is unclear and there are a number of competing theories. Research on children with ADHD has shown a general reduction of brain volume, but with a proportionally greater reduction in the volume of the left-sided prefrontal cortex. These findings suggest that the core ADHD features of inattention, hyperactivity, and impulsivity may reflect frontal lobe dysfunction, but other brain regions in particular the cerebellum have also been implicated. Neuroimaging studies in ADHD have not always given consistent results and as of 2008 are used only for research and not diagnostic purposes. A 2005 review of published studies involving neuroimaging, neuropsychological genetics, and neurochemistry found converging lines of evidence to suggest that four connected frontostriatal regions play a role in the pathophysiology of ADHD: The lateral prefrontal cortex, dorsal anterior cingulate cortex, caudate, and putamen.

In one study, a delay in development of certain brain structures by an average of three years occurred in ADHD elementary school-aged patients. The delay was most prominent in the frontal cortex and temporal lobe, which are believed to be responsible for the ability to control and focus thinking. In contrast, the motor cortex in the ADHD patients was seen to mature faster than normal, suggesting that both slower development of behavioral control and advanced motor development might be required for the fidgetiness that characterizes ADHD. It should be noted that stimulant medication itself may affect growth factors of the central nervous system.

The same laboratory had previously found involvement of the "7-repeat" variant of the dopamine D4 receptor gene, which accounts for about 30 percent of the genetic risk for ADHD, in unusual thinness of the cortex of the right side of the brain; however, in contrast to other variants of the gene found in ADHD patients, the region normalized in thickness during the teen years in these children, coinciding with clinical improvement.¹⁷

In addition, SPECT scans found people with ADHD to have reduced blood circulation (indicating low neural activity), and a significantly higher concentration of dopamine transporters in the striatum, which is in charge of planning ahead. A study by the U.S. Department of Energy's Brookhaven National Laboratory in collaboration

with Mount Sinai School of Medicine in New York suggest that it is not the dopamine transporter levels that indicate ADHD, but the brain's ability to produce neurotransmitters like dopamine itself. The study was done by injecting 20 ADHD subjects and 25 control subjects with a radiotracer that attaches itself to dopamine transporters.

The study found that it was not the transporter levels that indicated ADHD, but the dopamine itself. ADHD subjects showed lower levels of dopamine (hypodopaminergia) across the board. They speculated that since ADHD subjects had lower levels of dopamine to begin with, the number of transporters in the brain was not the telling factor. In support of this notion, plasma homovanillic acid, an index of dopamine levels, was found to be inversely related not only to childhood ADHD symptoms in adult psychiatric patients but to "childhood learning problems" in healthy subjects as well.

One interpretation of dopamine pathway tracers is that the biochemical "reward" mechanism works for those with ADHD only when the task performed is inherently motivating; low levels of dopamine raise the threshold at which someone can maintain focus on a task that is otherwise boring. Neuroimaging studies also found that neurotransmitters level (e.g. dopamine and serotonin) in the synaptic cleft goes down during depression.

A 1990 PET scan study by Alan J. Zametkin *et al.* found that global cerebral glucose metabolism was 8 percent lower in medication-naive adults who had been hyperactive since childhood. Further studies found that chronic stimulant treatment had little effect on global glucose metabolism, a 1993 study in girls failed to find a decreased global glucose metabolism, but found significant differences in glucose metabolism in 6 specific regions of the brains of ADHD girls as compared to control subjects. The study also found that differences in one specific region of the frontal lobe were statistically correlated with symptom severity.

Critics, such as Jonathan Leo and David Cohen, who reject the characterization of ADHD as a disorder, contend that the controls for stimulant medication usage were inadequate in some lobar volumetric studies, which makes it impossible to determine whether ADHD itself or psychotropic medication

used to treat ADHD is responsible for the decreased thickness observed in certain brain regions. While the main study in question used age-matched controls, it did not provide information on height and weight of the subjects. These variables it has been argued could account for the regional brain size differences rather than ADHD itself. They believe many neuroimaging studies are oversimplified in both popular and scientific discourse and given undue weight despite deficiencies in experimental methodology.¹⁸

Diagnosis: ADHD is diagnosed via a psychiatric assessment; to rule out other potential causes or comorbidities, physical examination, radiological imaging, and laboratory tests may be used.

In North America, the DSM-IV criteria are often the basis for a diagnosis, while European countries usually use the ICD-10. If the DSM-IV criteria are used, rather than the ICD-10, a diagnosis of ADHD is 3–4 times more likely. Factors other than those within the DSM or ICD however have been found to affect the diagnosis in clinical practice. A child's social and school environment as well as academic pressures at school are likely to be of influence.

Many of the symptoms of ADHD occur from time to time in everyone; in patients with ADHD, the frequency of these symptoms is greater and patients' lives are significantly impaired. Impairment must occur in multiple settings to be classified as ADHD. As with many other psychiatric and medical disorders, the formal diagnosis is made by a qualified professional in the field based on a set number of criteria. In the USA these criteria are laid down by the American Psychiatric Association in their Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), 4th edition.¹⁹

Based on the DSM-IV criteria listed below, three types of ADHD are classified:

1. ADHD, Combined Type: if both criteria 1A and 1B are met for the past 6 months
2. ADHD Predominantly Inattentive Type: if criterion 1A is met but criterion 1B is not met for the past six months
3. ADHD, Predominantly Hyperactive-Impulsive Type: if criterion 1B is met but criterion 1A is not met for the past six months.

The previously used term ADD expired with the most recent revision of the DSM. As a consequence, ADHD is the current nomenclature used to describe the disorder as one distinct disorder that can manifest itself as being a primary deficit resulting in hyperactivity/impulsivity (ADHD, predominately hyperactive-impulsive type) or inattention (ADHD, predominately inattentive type) or both (ADHD combined type).

DSM-IV: The diagnostic criteria outlined in DSM-IV assume that attention deficits

1. Are a distinct, differentiated condition?
2. Can be reliably measured using objective, behavioral measures; and
3. Are abnormalities resulting from organic/biological origins²⁰.

Six or more of the following signs of inattention have been present for at least 6 months to a point that is disruptive and inappropriate for developmental level:

Inattention:

1. Often does not give close attention to details or makes careless mistakes in schoolwork, work, or other activities.
2. Often has trouble keeping attention on tasks or play activities.
3. Often does not seem to listen when spoken to directly.
4. Often does not follow instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions).
5. Often has a trouble organizing activity.
6. Often avoids, dislikes, or does not want to do things that take a lot of mental effort for a long period of time (such as schoolwork or homework).
7. Often loses things needed for tasks and activities (such as toys, school assignments, pencils, books, or tools).

8. Is often easily distracted.
9. Often forgetful in daily activities.

Six or more of the following signs of hyperactivity-impulsivity have been present for at least 6 months to an extent that is disruptive and inappropriate for developmental level:

Hyperactivity:

1. Often fidgets with hands or feet or squirms in seat.
2. Often gets up from seat when remaining in seat is expected.
3. Often runs about or climbs when and where it is not appropriate (adolescents or adults may feel very restless).
4. Often has trouble playing or enjoying leisure activities quietly.
5. Is often "on the go" or often acts as if "driven by a motor".
6. Often talks excessively.

Impulsiveness:

1. Often blurts out answers before questions have been finished.
 2. Often has trouble waiting one's turn.
 3. Often interrupts or intrudes on others (example: butts into conversations or games).
- A. Some signs that cause impairment were present before age 7 years.
- B. Some impairment from the signs is present in two or more settings (such as at school/work and at home).
- C. There must be clear evidence of significant impairment in social, school, or work functioning.
- D. The signs do not happen only during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic

Disorder. The signs are not better accounted for by another mental disorder (such as Mood Disorder, Anxiety Disorder, Dissociative Identity Disorder, or a Personality Disorder).²⁰

ICD-10: In the tenth edition of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) the signs of ADHD are given the name "Hyperkinetic disorders". When a conduct disorder (as defined by ICD-10) is present, the condition is referred to as "Hyperkinetic conduct disorder". Otherwise the disorder is classified as "Disturbance of Activity and Attention", "Other Hyperkinetic Disorders" or "Hyperkinetic Disorders, Unspecified". The latter is sometimes referred to as, "Hyperkinetic Syndrome".

Other Guidelines: The American Academy of Pediatrics Clinical Practice Guideline for children with ADHD emphasizes that a reliable diagnosis is dependent upon the fulfillment of three criteria:

- The use of explicit criteria for the diagnosis using the DSM-IV-TR.
- The importance of obtaining information about the child's signs in more than one setting.
- The search for coexisting conditions that may make the diagnosis more difficult or complicate treatment planning.

All three criteria are determined using the patient's history given by the parents, teachers and/or the patient.

Adults often continue to be impaired by ADHD. Adults with ADHD are diagnosed under the same criteria, including the stipulation that their signs must have been present prior to the age of seven. Adults face some of their greatest challenges in the areas of self-control and self-motivation, as well as executive functioning, usually having more signs of inattention and fewer of hyperactivity or impulsiveness than children does.

The American Academy of Child Adolescent Psychiatry (AACAP) considers it necessary that the following be present before attaching the label of ADHD to a child:

- The behaviors must appear before age 7.
- They must continue for at least six months.
- The symptoms must also create a real handicap in at least two of the following areas of the child's life; in the classroom, on the playground, at home, in the community, or in social settings.

If a child seems too active on the playground but not elsewhere, the problem might not be ADHD. It might also not be ADHD if the behaviors occur in the classroom but nowhere else. A child who shows some symptoms would not be diagnosed with ADHD if his or her schoolwork or friendships are not impaired by the behaviors.

Differential: To make the diagnosis of ADHD, a number of other possible medical and psychological conditions must be excluded.

Medical Conditions: Medical conditions that must be excluded as causing the ADHD symptoms include: hypothyroidism, anemia, lead poisoning, chronic illness, hearing or vision impairment, substance abuse, medication side-effects, sleep impairment and child abuse, and cluttering (tachyphemia) among others.

Sleep Conditions: As with other psychological and neurological issues, the relationship between ADHD and sleep is complex. In addition to clinical observations, there is substantial empirical evidence from a neuroanatomic standpoint to suggest that there is considerable overlap in the central nervous system centers that regulate sleep and those that regulate attention arousal. Primary sleep disorders play a role in the clinical presentation of symptoms of inattention and behavioral dysregulation. There are multilevel and bidirectional relationships among sleep, neurobehavioral functioning and the clinical syndrome of ADHD.

Behavioral manifestations of sleepiness in children range from the classic ones (yawning, rubbing eyes), to externalizing behaviors (impulsivity, hyperactivity, aggressiveness), to mood lability and inattentiveness. Many sleep disorders are important causes of symptoms that may overlap with the cardinal symptoms of ADHD; children with ADHD should be regularly and systematically assessed for sleep problems.

From a clinical standpoint, mechanisms that account for the phenomenon of excessive daytime sleepiness include:

- Chronic sleep deprivation, that is insufficient sleep for physiologic sleep needs,
- Fragmented or disrupted sleep, caused by, for example, obstructive sleep apnea (OSA) or periodic limb movement disorder (PLMD),
- Primary clinical disorders of excessive daytime sleepiness, such as narcolepsy and
- Circadian rhythm disorders, such as delayed sleep phase syndrome (DSPS).²¹

Management: Methods of treatment often involve some combination of behavior modification, lifestyle changes, counseling, and medication. A 2005 study found that medical management and behavioral treatment is the most effective ADHD management strategy, followed by medication alone, and then behavioral treatment. While medication has been shown to improve behavior when taken over the short term, they have not been shown to alter long-term outcomes. Medications have at least some effect in about 80% of people. Dietary modifications may also be of benefit.

Psychosocial: The evidence is strong for the effectiveness of behavioral treatments in ADHD. It is recommended first line in those who have mild symptoms and in preschool-aged children. Psychological therapies used include psychoeducational input, behavior therapy, cognitive behavioral therapy (CBT), interpersonal psychotherapy (IPT), and family therapy, school-based interventions, social skills training, parent management training, neurofeedback, and nature exposure. Parent training and education have been found to have short-term benefits. There is a deficiency of good research on the effectiveness of family therapy for ADHD, but the evidence that exists shows that it is comparable in effectiveness to treatment as usual in the community and is superior to medication placebo. Several ADHD specific support groups exist as informational sources and to help families cope with challenges associated with dealing with ADHD.

Medication:



Methylphenidate (Ritalin) 10 mg tablets

Stimulant medications are the medical treatment of choice. There are a number of non-stimulant medications, such as atomoxetine, that may be used as alternatives. There are no good studies of comparative effectiveness between various medications, and there is a lack of evidence on their effects on academic performance and social behaviors.

While stimulants and atomoxetine are generally safe, there are side-effects and contraindications to their use. Medications are not recommended for preschool children, as their long-term effects in such young people are unknown. There is very little data on the long-term benefits or adverse effects of stimulants for ADHD.

Any drug used for ADHD may have adverse drug reactions such as psychosis and mania, though methylphenidate-induced psychosis is uncommon. Regular monitoring of individuals receiving long-term stimulant therapy for possible treatment emergent psychosis has been recommended. People with ADHD have an increased risk of substance abuse, and stimulant medications reduce this risk. Stimulant medications in and of themselves however have the potential for abuse and dependence. Guidelines on when to use medications vary internationally, with the UK's National Institute of Clinical Excellence, for example, recommending use only in severe cases, while most United States guidelines recommend medications in nearly all cases²².

Prognosis: Children diagnosed with ADHD have significant difficulties in adolescence, regardless of treatment. In the United States, 37 percent of those with ADHD do not get a high school diploma even though many of them will receive special education services.

A 1995 briefing citing a 1994 book review says the combined outcomes of the expulsion and dropout rates indicate that almost half of all ADHD students never finish high school. Also in the US, less than 5 percent of individuals with ADHD get a college degree compared to 28 percent of the general population. The proportion of children meeting the diagnostic criteria for ADHD drops by about 50 percent over three years after the diagnosis.

This occurs regardless of the treatments used and also occurs in untreated children with ADHD. ADHD persists into adulthood in about 30 to 50 percent of cases. Those affected are likely to develop coping mechanisms as they mature, thus compensating for their previous ADHD.²³

Epidemiology: ADHD's global prevalence is estimated at 3 to 5 percent in people under the age of 19. There is, however, both geographical and local variability among studies. Children in North America appear to have a higher rate of ADHD than children in Africa and the Middle East. Published studies have found rates of ADHD as low as 2 percent and as high as 14 percent among school-aged children.

The rates of diagnosis and treatment of ADHD are also much higher on the East Coast of the USA than on the West Coast. The frequency of the diagnosis differs between male children (10%) and female children (4%) in the United States. This difference between genders may reflect either a difference in susceptibility or those females with ADHD are less likely to be diagnosed than males²⁴.

Rates of ADHD diagnosis and treatment have increased in both the UK and the USA since the 1970s. In the UK an estimated 0.5 per 1,000 children had ADHD in the 1970s, while 3 per 1,000 received ADHD medications in the late 1990s. In the USA in the 1970s 12 per 1,000 children had the diagnosis, while in the late 1990s 34 per 1,000 had the diagnosis and the numbers continue to increase.²⁵

In the UK in 2003 a prevalence of 3.6 percent is reported in male children and less than 1 percent is reported in female children²⁶.

Prevention of Attention-Deficit:

Hyperactivity Disorder: Preventive measures to reduce the incidence of ADHD in children are not

known at this time. However, early detection and intervention can reduce the severity of symptoms, decrease the interference of behavioral symptoms on school functioning, enhance the child's normal growth and developmental process, and improve the quality of life experienced by children or adolescents with ADHD.

However, there are a few steps that could help prevent problems caused by ADHD and assure your child is as physically, mentally and emotionally healthy as possible:

- During pregnancy, avoid anything that could harm fetal development. Don't drink alcohol, smoke cigarettes or use drugs.
- Protect your child from exposure to pollutants and toxins, including cigarette smoke, agricultural or industrial chemicals, and lead paint (found in some old buildings).
- Be consistent, set limits and have clear consequences for your child's behavior.
- Put together a daily routine for your child with clear expectations that include such things as bedtime, morning time, mealtime, simple chores and television.
- Avoid multitasking yourself when talking with your child, make eye contact when giving instructions, and set aside a few minutes every day to praise your child.
- Work with teachers and caregivers to identify problems early. If your child does have ADHD or another condition that interferes with learning or social interaction, early treatment can reduce the impact of the condition.

Poor nutrition is a significant concern for attentional problems and ADHD, here are some of the dietary factors that have been linked to ADHD risk in scientific studies:

- High sugar intake is also associated with hyperactive behavior and ADHD.
- Inadequate micronutrient intake. Supplementation to correct micronutrient deficiencies has been shown to improve ADHD symptoms.

- A low-nutrient diet high in processed foods and soft drinks at age 4 ½ has been associated with hyperactivity in children at age 7. Similarly, a “western” dietary pattern has also been associated with ADHD in 14-year-olds.
- Food additives and dyes: many colored foods are marketed to children, and hyperactivity in children following ingestion of food dyes is well documented in placebo-controlled studies. Furthermore, a 2004 meta-analysis of 16 studies in children who were already hyperactive showed that their hyperactive behavior increased after ingesting food colorings.
- There is preliminary evidence that certain pesticides, organophosphates commonly found on some fruits are associated with ADHD.
- Omega-3 fatty acids (especially DHA) are the building blocks a child needs to build a healthy brain. Insufficient omega-3 levels are common in children with ADHD, and there is evidence that omega-3 supplementation, especially in combination with the omega-6 fatty acid Gamma-Linolenic Acid GLA; found in borage oil and evening primrose oil improves behavior and ADHD symptoms.²⁷

CONCLUSION Although much progress has been made in our understanding of the diagnosis and treatment of ADHD, much has yet to be researched, particularly for adolescents. It is clear that the current diagnostic criteria, although valid for children, may need to be modified for adolescents and adults, to reflect the developmental changes that take place as children approach adulthood. How the subtypes change in the transition from childhood to adolescence and how the patterns of comorbidities change need to be identified more clearly.

The recent pressure and incentives that the government has placed on the pharmaceutical industry have increased the number of pharmaceutical company-sponsored studies among adolescents.

However, additional studies are required to clarify how medication needs, types, dosages, and frequencies of administration differ among adolescents and adults, compared with children. Given the developmental significance of social

functioning, additional studies of the development and evaluations of psychosocial interventions targeting these behaviors are greatly needed. The unique aspects of obtaining adolescents’ adherence to treatment are important factors requiring clarification. Lastly, longitudinal studies examining the outcomes for adolescents and adults are required to identify more clearly the course of the disorder and the impact of treatment.

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