

Attention Deficit Disorder (ADD) Attention Deficit Hyperactive Disorder (ADHD)

Is it a product of our modern lifestyles?

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Abstract

ADHD is a complex disorder of impairment of brain functions, which burdens our society with significant financial costs. Its salient features are inattention, hyperactivity, and impulsivity. In many cases, it is accompanied by one or more serious psychiatric comorbidities. Criteria for its diagnosis have emerged over the past four decades, resulting in better recognition and more widespread treatment. The current opinion estimates its prevalence in the USA to be 5 – 10% among school-aged children. It has strong heritability and genetic links, as well as environmental predispositions and triggers. Although it mostly affects school-aged children, it is well known to affect preschoolers, youths, and even adults, with distinct manifestations and progression. Treatment predominantly relies on prescribing stimulant medications (amphetamines), of which methylphenidate is the most widely used. Psychosocial therapy has an important but less distinguished role in the management of the disorder.

Attention Deficit Disorder?

Attention Deficit Disorder (ADD) or Attention Deficit Hyperactive Disorder (ADHD) is a complex syndrome of impairments in developmental unfolding of the unconscious self-management system of the brain that affects significant numbers of children, adolescents, and adults, and often can be treated effectively with appropriate medication.¹

General Considerations

The disorder was first described in 1902 by a London pediatrician, Dr. George Still, who initially thought it was the result of a viral encephalitis. He described it as a “moral defect” in which the patient has “inhibition of the will.” He believed that affected children had depressed mothers and alcoholic fathers.

In the 1930s the disorder was attributed to minimal brain damage or minimal brain dysfunction. Amphetamines were found to be efficacious in controlling symptoms. In the 1950s it was called the “Hyperactive Child Syndrome.”²

Since then, the criteria for diagnosis have continually changed.² In 1968 the first criteria appeared in the DSM II (Diagnostic and Statistical Manual). These were modified in 1980 in the DSM III³, then again in 1987 (DSM III R). Significant changes were introduced to the next editions, DSM IV in 1994⁴ and DSM IV TR in 2000.⁵

Current literature suggests the presence of the following distinctive subtypes of the disorder:

- Inattentive Subtype (pure ADD)
- Hyperactive – Impulsive Subtype (classic ADHD)
- Combined Subtype
- ADHD with Co-morbidities

The estimated annual cost of the disorder in the US is about \$31 billion, divided as follows:

- Treatment for ADHD patients\$ 1.6 Billion
- Other healthcare cost for patients.....\$ 12.1 Billion
- Healthcare costs to families.....\$ 14.2 Billion
- Work loss costs to adults\$ 3.7 Billion

Diagnostic Criteria

The patient has to demonstrate the following:

1. Maladaptive symptoms inconsistent with developmental level, persisting for at least six months, of either inattention (6 criteria) or hyperactivity-impulsivity (6 criteria).

2. Some of these impairing symptoms were present before the age of seven.
3. Impairment is present in two or more settings (e.g., at school and at home).
4. Clear evidence of clinically significant impairment in social, academic, or occupational functioning.
5. The symptoms are not better accounted for by another mental disorder.

Six or more of the following symptoms are needed to meet the criteria of inattention:

- Often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities.
- Often has difficulty sustaining attention in tasks or play activities.
- Often does not seem to listen when spoken to directly.
- Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace.
- Often has difficulty organizing tasks and activities.
- Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort.
- Often loses things necessary for tasks or activities.
- Is often easily distracted by extraneous stimuli.
- Is often forgetful in daily activities.

Hyperactivity

Six or more of the following symptoms are needed to meet the criteria of hyperactivity-impulsivity:

- Often fidgets with hands or feet or squirms in seat.
- Often leaves seat in classroom when remaining seated is expected.
- Often runs about or climbs excessively when it is inappropriate.
- Often has difficulty playing or engaging in leisure activities quietly.
- Is often “on the go” or often acts as if “driven by a motor.”
- Often talks excessively.

Impulsivity

- Often blurts out answers before questions have been completed.
- Often has difficulty awaiting turn.
- Often interrupts or intrudes on others (e.g., butts into conversations).

Statistical Prevalence

In 1999 the US Surgeon on Mental Health stated that 3 – 5% of school-aged children had ADHD.⁶ Since then, screening for and diagnosing the disorder has been enhanced.

In 2001, the National Institute of Mental Health (NIMH) stated that ADHD affects an estimated 4.1% of youths between the ages of 9 and 17 years. Also, in 2001, the Mayo Clinic studies used a figure of 7.5%, while the American Academy of Pediatrics reviewed epidemiologic studies showing prevalence rates in the range of 4 – 12%.

In 2002, the CDC reported that approximately 7% (1.623 million) of children in the US between the ages of 6 and 11 years had ADHD. Of these 3.3% (784,000) had ADHD without a learning disability, and 3.5% (839,000) had ADHD and a learning disability.

A review of over 9000 studies and surveys between the years 1978 and 2005 estimated a pooled prevalence rate of 5.23%.⁷ Another pooled estimate of 71 studies between 1997 and 2007 found the prevalence to vary between 0.9 – 27%. Most of this variability was accounted for by the different methods of survey and diagnosis.

The currently accepted rate is about 5 – 10%. Boys are 2.4 – 4 times more likely to have the illness than girls. The disorder is found in all cultures; and is known to persist into adulthood. The overall prevalence in adults is about 4.4%. About 35 – 65 % of ADHD children will continue to have the disorder in adulthood. Of these, 15% will show no improvement in adult life, while the remainder will experience partial improvement.⁸

The most frequently co-occurring disorders were:

- Oppositional Defiant Disorder (33%)
- Conduct Disorder (25%)
- Anxiety Disorder (25%)
- Depressive Disorders (20%)
- Substance Abuse Disorders (15 – 25%)
- Learning Disabilities, particularly Executive Function Disorder (EFD: 12 – 22%)
- Eating Disorders in Females (20%)

Epidemiologic Challenges

It has always been a challenge to define the exact prevalence of the disorder in our society. Often, an accurate clinical diagnosis is too costly for large epidemiologic surveys. It requires the use of highly paid clinicians and specialists for extended periods of time. Using a structured diagnostic interview has been found to be cheaper. This, however, requires trained interviewers and is not as accurate. The most practical data-collecting methods have been the use of diagnostic checklists and rating scales, but they do not effectively evaluate impairment.⁹ Criteria for diagnosis according to the DSM – IV (used in the USA) generated higher prevalence rates than criteria using ICD – 10

(International Classification of Disease, used in Europe). The DSM – III required 8 out of 14 criteria for diagnosis³, while DSM – IV required 6 out of 9 criteria.⁴ The overlap between patients diagnosed following the criteria of DSM – III and those of DSM – IV was 87%.

There is an inherent tendency to misdiagnose any disorder based upon abstract, less quantitative, and varied symptoms. ADHD tends to be diagnosed by a wide variety of healthcare professionals using varying means of testing. The lack of standardized testing leads to confusion and misdiagnosis for many patients. In practice, the diagnosis is often made in children who meet some but not all of the criteria recommended in DSM – IV.

For instance, inter-rater reliability between parents and teachers who are reporting the child's symptoms tended to be low. Relying exclusively on parental report of ADHD, especially in preschoolers, was found to result in over-identification of ADHD. Furthermore, many children with ADHD have co-morbidities that could be contributing to the impairment.⁹ Also, several unrelated disorders can be easily misdiagnosed as ADHD, such as:

- Emotional Disorders
- Traumatic Brain Injury (TBI)
- Sleep Disorders as Sleep Apnea & Restless Leg Syndrome (RLS)
- Disorders along the Spectrum of Autism

Is the Prevalence Rising?

Symptoms of the inattentive type of ADHD usually manifest when reading and independent work are required in school. Today, ADHD is more evident for a number of reasons, one of which is the fast pace requiring advanced thinking skills earlier in life.¹⁰ We challenge our preschool children before they are mature enough to meet these challenges.

Changes in our social structure over the past fifty years may have contributed to a rise in the prevalence of the disorder. For instance, inconsistent parenting and low involvement by fathers were found to be risk factors for ADHD. Other factors that have been found to correlate with ADHD and its persistence into adulthood are: family dysfunction, parental psychopathology, poor peer relations, low self-esteem, lower academic achievement, and school failure.

Biological Causes of ADHD

ADHD runs in families, suggesting that inheritance is an important risk factor. About 10 – 35% of children with ADHD have a first-degree relative with past or present ADHD, and approximately one-half of parents who had ADHD have a child with the disorder. When ADHD is present in one twin, it is more likely to be present in an identical twin than in a fraternal twin. The heritability of ADHD is believed to be one of the highest in the disorders of psychiatry 75 – 80%.¹¹

Symptoms of ADHD respond well to treatment with stimulants, hence the “dopamine hypothesis” that ADHD is due to inadequate availability of dopamine in the CNS. Genetic variations in dopamine-receptor genes (DRD4 & DRD5) on chromosome 11 are associated with a modest increase in ADHD risk. Abnormalities in a dopamine-transporter gene (DAT) on chromosome 5 are found in children with very severe forms of ADHD. Other genes were also linked to ADHD, such as the Dopamine Beta Hydroxylase gene (DBH), the glutamate receptor gene (GRM7), the serotonin transporter gene (5HTT), and the serotonin receptor 1B gene (HTR1B).¹² In the most in-depth genetic association study (the IMAGE project), evidence was found for the association of ADHD with 18 genes.¹¹ None of the investigated genes has proven to be sufficient or necessary for causing the disorder.¹³

The genetic architecture of ADHD appears to be complex and interacts with multiple environmental factors to cause the disorder.¹¹ This interaction is evidenced in hyperactivity and inattention being observed more commonly in children who had mothers that smoked during pregnancy; mothers that had a lack of oxygen in the neonatal period, or mothers that have been exposed to high quantities of lead or mercury.¹³ Social trauma and marital conflicts may precipitate ADHD in predisposed children.

Recent neuro-anatomic studies have shown that the brains of patients have abnormalities in specific regions: the anterior cingulate cortex, the dorsolateral prefrontal cortex, the splenium of the corpus callosum, the caudate nucleus, and the cerebellum.

Brain images of patients with ADHD, obtained by PET scans, show significant improvement in caudate nucleus functions from baseline, after treatment with oral methylphenidate.¹⁴ Other studies have demonstrated that parents of children with ADHD have Prefrontal Cortex hypoactivity.¹⁵ Adult ADHD Patients showed deficient maturation of the Prefrontal Cortex, manifested as volumetric reductions.¹⁶

Developmental Complexities

ADHD is a complex disorder of childhood in which there is impairment of various executive functions (cognitive dysfunction), perhaps related to developmental abnormalities in the prefrontal cortex. ADHD symptoms may be noticeable in early childhood but often are not apparent until the individual encounters challenges of adolescence or adulthood.¹ These deficits in Executive Functions (31% in ADHD versus 16% in controls) include set shifting (shifting from following one set of commands to another), planning, working memory, inhibition (the ability to resist distraction), attention, and initiation.

ADHD appears to be a problem of insufficient will power because all patients with this disorder are able to pay attention very well for some specific activities that intensely interest or frighten them, but they have chronic difficulty in maintaining adequate focus for many other activities.¹

Although current diagnostic criteria for ADHD do not include impairments in self-regulation of emotion, chronic difficulties in this domain seem to be characteristic of most persons affected with this syndrome.

Many patients with other psychiatric diagnoses also have the ADD syndrome. In such cases, adequate treatment may require the clinician to provide direct intervention for their ADHD symptoms and for other disorders.¹

Most patients with ADHD also have, at some point in life, one or more additional disorders of learning, emotions, or behavior. To provide adequate treatment, the clinician needs to attend not only to the patient's ADHD symptoms but also to relevant impairments from co-morbid disorders.¹

ADHD in Preschool Children

Prevalence of ADHD in preschoolers is comparable to incidence rates among school-aged children (2–6%). These symptoms have been shown to be stable and predictive of continued behavior difficulties in 45% of those evaluated.¹⁷ The ADD subtype is rare (about 2%), while the ADHD subtype is the predominant one and is associated with severe impairment.¹⁸

More than 70% of preschoolers diagnosed with ADHD have at least one other co-morbid diagnosis. Early age at onset is often associated with increased comorbidity. Almost 25% of preschoolers diagnosed with ADHD also have impaired speech or language problems.¹⁷

ADHD in preschoolers is often associated with significant impairments across most domains of the young child's life including home, school, safety, and social functioning.¹⁷ They are more often suspended from daycare or preschool because of disruptive behavior. They experience more academic impairment. They have an increased risk for accidents, injuries, or poisonings, and more ED visits (an average of 18 visits in 15 months).¹⁹ Symptoms of risky behavior may include broken bones; concussions, leaning out of windows, running into traffic-filled streets, turning on the stove, spilling bleach, etc.

Relying exclusively on parental report of ADHD in preschoolers may result in over-identification of ADHD. However; problems of inattention may not be as apparent as other ADHD symptoms until the child enters school. Many preschoolers with ADHD do not receive adequate evaluation or treatment.¹⁷

The NIMH Preschool ADHD Treatment Study reported that methylphenidate is effective in treating ADHD in preschoolers, although dosing should be started lower and titrated more conservatively than with older children.¹⁷ Symptom reduction was proportional to dosage.

The average "best" methylphenidate total daily dose was 14 mg.

Parent training and/or psychosocial treatment may be useful for preschoolers, but if a parent has ADHD, treatment of the parent's ADHD may be a prerequisite to the preschooler's benefiting from such treatment.¹⁷

ADHD in School Children

Elementary school-age children with ADHD typically have significant difficulties with academic achievement and peer relationships. They obtain significantly lower scores on achievement tests than do their peers without ADHD and are at higher-than-average risk for grade retention and placement in special education.²⁰

Approximately 30% of the children with ADHD also have a learning disability. However, their academic difficulties typically are the result of performance rather than skills deficits. Specifically, these difficulties appear to be secondary to the inherent problems they have with engagement in class activities and instruction, as well as inconsistent completion and accuracy on assigned tasks, tests, and projects.²⁰

School-based intervention strategies should target deficits in behavior control, academic performance, and social relationships. A balanced treatment plan that includes proactive (antecedent-based) and reactive (consequence-based) strategies is optimal.²⁰

Family-school interventions (such as conjoint behavioral consultation, daily report card, targeted homework intervention) capitalize on the potential benefits of promoting family involvement in education and family-school collaboration. These strategies may be particularly helpful when combined with effective school-based interventions.²⁰

Multimodal interventions usually are required to successfully address the problems presented by children with ADHD. The need for multiple interventions necessitates that professionals from many disciplines be involved in the care of these children. Interdisciplinary collaboration is essential to ensure a comprehensive, well-integrated, systemic approach to treatment.²⁰

Interventions should be designed based on assessment data (e.g., functional behavioral assessment) through collaboration among clinicians, educational professionals, and parents. Multiple mediators (e.g., teachers, parents, peers, computer technology) should be used to implement interventions, particularly in classroom settings.²⁰

ADHD in Adolescents

ADHD continues into adolescence, causing impairments in school, at home, and in the community²¹ including school problems or school dropout, earning less than \$ 25,000 per year, more than one speeding ticket per 12 months, criminal arrests, and teen pregnancies.

Adolescents with ADHD present in many different ways, and the astute clinician needs to look beyond the presenting problems to make a differential diagnosis. The clinician should take the teenager's concerns about the ADHD diagnosis seriously and address them meaningfully to enlist the teenager's cooperation with treatments. Physicians should include the adolescent in all stages of decision-making surrounding medication.²¹

A comprehensive treatment program includes ADHD education, medication, school and family interventions, and co-morbidity interventions. A combination of behavior management training and problem-solving communication training has been shown to be effective for addressing conflict between parents and adolescents with ADHD. An effective intervention for school problems should include a home and school communication system, a homework contract, backpack organization, and classroom modifications.²¹

Adult ADHD

About two-thirds of children with ADHD continue to have symptoms into adulthood. Symptoms gradually abate with increasing age, generally following a predicted pattern:

- Hyperactivity mostly declines at 9 – 11 years
- Impulsivity mostly declines at 12 – 14 years
- Inattention mostly persists beyond age 20

Some adults with ADHD did not start having symptoms until later in childhood, during the ages 7 to 12 years. The overall prevalence of ADHD in the adult population is about 4.4%. About 15% – 30% will fulfill all diagnostic criteria for ADHD (Persistent ADHD), while many children with ADHD (30% – 50%) will continue to have symptoms of ADHD into adulthood without meeting full criteria for diagnosis (Remitted or Residual ADHD).

Persistence of ADHD symptoms correlates with the severity of the childhood disorder and its associated co-morbidities. Males are slightly more affected than females. Nearly 50% of children born to adult ADHD patients will have ADHD.²²

The adult symptoms of inattention include:

- Easily distracted and forgetful
- Poor concentration
- Poor time management
- Difficulty finishing tasks
- Misplaces things
- Difficulty sustaining attention to reading or paperwork

The adult symptoms of hyperactivity include:

- Inner restlessness
- Self-select active jobs
- Overwhelmed
- Talks excessively (particularly females)
- Fidgets when seated
- The adult symptoms of impulsivity include:
 - Impulsive job changes
 - Drives too fast, has traffic accidents
 - Irritability or quickness to anger

Adults with ADHD have significant impairment. These impairments are manifested in various aspects of their lives, such as: dysfunctional or failed marriages, unemployment, criminal arrests and car accidents, substance abuse or addictions, poor relationships with parents and peers, and substandard academic performance.²³

Pharmacological Treatment

Psycho-stimulants are highly effective for 75 – 90% of children with ADHD. They consistently reduce ADHD core features.² They have their greatest effects on symptoms of hyperactivity, impulsivity, and inattention, and the associated defiance and aggression. They improve classroom performance and behavior and promote increased interaction. Yet, psycho-stimulants do not appear to change long-term outcomes such as peer relationships, social or academic skills, or school achievement.²⁴

The most common stimulant medications (amphetamines) are:

- Methylphenidate: MPH (Ritalin, Ritalin SR, Ritalin LA, Methylin, Metadate, Metadate CD)
- MPH Transdermal Patch (Daytrana)
- Dexmethylphenidate (Focalin, Focalin XR)
- Oros – Methylphenidate (Concerta)
- Dextroamphetamine (Dexedrin, Adderall, Adderall XR)
- Pemoline (Cylert)
- Lis-Dexamfetamine (Vyvanse)

Children who do not respond to one stimulant may respond to another. They are usually started at a low dose and adjusted weekly. Common side effects include insomnia, anorexia, irritability and jitteriness, anxiousness, daydreams, biting fingernails, sadness, stomach aches, and headaches. Most of the side effects are mild; they tend to recede over time and/or respond to dose changes.²⁴

Pemoline has been associated with hepato-toxicity so monitoring of liver functions is needed. Prescreening for Hypertrophic Cardiomyopathy, CAD, and arrhythmias is necessary before prescribing any of these stimulants.² Overdose or toxicity may precipitate mania. There has been no significant effect demonstrated on growth potential as well as no significant effect on future substance abuse, when appropriately prescribed.

There have been major increases in the number of stimulant prescriptions since 1989 (2.5 X increase within one decade). Most researchers believe that much of the increased use reflects better diagnosis and more consistent treatment, especially in adults, minorities, girls, and publically-funded patients. However, the majority of children and adolescents who are receiving stimulants did not fully meet the criteria for ADHD. Stimulants can be drugs of abuse, raising concerns about the potential of their abuse by children. However, case reports are rare.

For the 10 – 30% who do not respond to stimulants, or those who cannot tolerate the side effects, there are other medications. Response to antidepressants such as Bupropion is not as strong

as with stimulants. It can also be used as adjunct to stimulant therapy. Others drugs that have been used are Modafenil and Atomoxetine. Neuroleptics are occasionally effective but carry the risk of tardive dyskinesia.²⁴

Psychosocial Treatment

Behavioral techniques typically employ “time-out,” point systems, the use of a daily report card, and contingent attention. Psychosocial treatment is useful for the child who does not respond to medication at all, who responds only partially to medication, who cannot tolerate medication, or for whom the therapeutic benefits of the medication have worn off. Psychoeducation, by providing information about ADHD and treatment options, is considered critical in developing a comprehensive treatment plan.²⁵

Systematic programs of intensive contingency management, conducted in specialized classrooms, with the setting controlled by highly trained individuals, is the most effective of the behavioral techniques.²⁵ These programs are frequently structured following the model of a summer school. Teachers are trained in specialized skills that help manage ADHD students.²⁶ The efficacy of behavioral training of teachers is well established, while that of parent training is less evidenced.²⁵

Psychosocial treatment has its limitations. To be fully effective, these treatments need a consistency and comprehensiveness that is hard to achieve. Behavioral interventions tend to improve targeted behaviors but not the core symptoms. Studies comparing training of parents and teachers’ behavioral techniques, with the use of stimulants, have shown that improvements in the symptoms of ADHD are not as large as with psycho-stimulants.²⁵

Educational accommodations for children with ADHD are federally mandated. Organizations, such as Children and Adults with ADD (CHADD) and the National ADD Association, can be helpful resources.²⁵

Treatment Considerations

Medication used together with multiple psychosocial interventions in multiple settings (multimodal treatment) improved social skills, parent-child relations, anxiety symptoms, reading achievement, oppositional or aggressive symptoms, and parent satisfaction. However, it did not yield additional benefits for core ADHD symptoms over medication alone.

ADHD has an early onset and requires an extended course of treatment. A diagnosis of ADHD requires histories to be taken from multiple sources, is time consuming, and requires multiple clinical skills. In real life, family practitioners are more likely than either pediatricians or psychiatrists to prescribe stimulants. Thus, research is still needed to examine the long-term safety of stimulant treatment and options for lowering the dose.

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