



Attention Deficit Hyperactivity Disorder: Epidemiology, Impact and Management

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Abstract

Attention deficit hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorders; with a prevalence ranging from 2% to 7%. ADHD has serious negative impacts on academic pursuits, employment, and social life. Diagnosis of ADHD is merely based on clinical evaluation determined by a set of criteria. Management of the disorder is multimodal, through the integration of medications with behavioral and psychological approaches. The objective of this review article is to spotlight the various aspects of the disorder.

Keywords: Attention deficit hyperactivity disorder, ADHD.

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Introduction:

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental condition characterized by impaired attention, disorganization, and/or hyperactivity-impulsivity at levels that are inconsistent with age or developmental stage. The definition of ADHD has evolved over the past 50 years. From its initial description in the Diagnostic and Statistical Manual of Mental Disorders (second edition; DSM-II) as a hyperkinetic reaction of childhood, to its current definition in DSM-5 as a

lifespan neurodevelopmental condition with specific criteria for children and adults¹. Given the several catastrophic consequences of ADHD; the current article's objective is to shed light on the different aspects of this illness.

Risk factors:

- **Genetic:**

The heritability of ADHD is between 75 and 90% based on twin and family studies. Experts have discovered numerous genes thought to contribute to the disorder's vulnerability. This comprises genes involved in modulating the dopaminergic system in the brain as well as those that control the expression of the Brain-Derived Neurotrophic Factor, which is vital for learning and memory².

- **Environmental:**

ADHD has been linked to prenatal exposure to neurotoxins (such as lead), infections (such as encephalitis), and alcohol exposure in utero have been correlated with subsequent ADHD, however, it is unclear whether these associations are causal. Prenatal smoking exposure is associated with ADHD even after controlling for parental psychiatric history and socioeconomic status. A higher risk of ADHD is associated with extremely low birth weight³. The degree of prematurity conveys a greater risk for ADHD, the higher the extremely low weight, the higher the risk⁴.

- **Behavioral:**

Reduced behavioral inhibition, effortful control, restraint, negative emotionality; and/or elevated novelty seeking, are all connected with ADHD⁵.

- **Course modifiers:**

Early childhood family interaction patterns are unlikely to cause ADHD directly, but they may have an impact on its course or play a role in the secondary development of behavioral problems⁴.

Prevalence:

Two types of ADHD prevalence should be identified: Community and administrative prevalence: **Community prevalence** refers to "the number of people with ADHD in a representative population sample, according to predefined criteria". **Administrative prevalence** which describes "the number of people with clinically

diagnosed or recorded ADHD as a proportion of the whole population (ie, the prevalence of diagnosis made in practice) ⁶.

Worldwide, systematic reviews show that the community prevalence ranges from 2% to 7%, hovering around 5% on average ⁶, another study assessed that there is at least one child with ADHD features in every classroom ⁷. In Arab countries, the prevalence of ADHD ranges from 1.3% to 16% ⁸. In Egypt, 9.3% of preschoolers were diagnosed with ADHD ⁹.

There are several different estimates of the administrative prevalence (clinically diagnosed or registered), and they have been rising over time. In the USA, the administrative prevalence of ADHD in children -based on prescriptions- increased from 0.6% in 1987 to 10% in 1995-1996. Administrative prevalence -determined by diagnosis- increased from 0.93% in 2002 to 11.0% in 2003 – 2011. Across studies, an escalation in the prevalence of ADHD was seen, with a peak in the 10- to 14-year-old age range ⁶.

No studies in the UK; based on prescriptions, prevalence ranged from 0.003% in 1992 to 0.92% in 2008. Administrative prevalence based on prescriptions with or without a diagnosis ranged from 0.19% in 1998 to 0.76% in 2011–12.

The administrative prevalence of ADHD has been rising over time, while the community prevalence has remained stable. This trend likely reflects improved identification and awareness of the condition and improved access to treatment in nations where underdiagnosis has been a problem ⁶. Studies have offered additional explanations for the rise in ADHD besides simply diagnostic changes, such as increased public and physician awareness of the diagnosis, geographic location, and cultural differences, as well as other public health-related factors like better access to care ¹⁰. For example, ADHD even has an awareness month of its own As of October 2004. A brief Google Trend search demonstrates a consistent rise in search results for ADHD over the years, social media has also helped bring ADHD into the public eye. On TikTok, the hashtag #adhd has received 11.4 billion views as of May 2022. Many patients attribute their use of these platforms to their realization of their illness and subsequent pursuit of treatment ¹¹.

Impact of ADHD on public health:

ADHD is a serious public health concern, due to its high incidence, chronic nature, severe effects on academic achievement, family life, and peer relationships, as well as its projected annual cross-sector costs of \$38–72 billion ³.

- **Comorbidities:**

Substance use disorder (SUD), obesity, mood disorders, and anxiety disorders are more common in ADHD patients than with non-ADHD controls. Patients with ADHD have odds ratios (OR) that are three to six times higher (SUD: 3.5; obesity: 1.9; mood disorders: 5.7; anxiety disorders: 4.0) ¹². Even though males are more likely to have ADHD, females with ADHD have a greater risk of several comorbid illnesses, including oppositional defiant disorder, autism spectrum disorder, and personality and substance use disorders ⁴.

- **Association With Suicidal Thoughts or Behavior:**

Children who have ADHD are more likely to have suicidal thoughts and suicidal behavior. Similarly, ADHD in adults is linked to an increased risk of suicide attempts when co-occurring with behavior, mood, or substance use problems, even after controlling for comorbidity. Additionally, compared to non-ADHD control individuals, people with ADHD experience more suicidal thoughts ⁴.

- **Economic burden of ADHD:**

The economic impact of ADHD is classified in two analysis categories: estimates based on total cost' and 'Estimates based on marginal costs' ¹³.

The first analysis method calculated all expenses incurred by an individual with ADHD over a year, as reported by research. This analysis offers overall direct, indirect, education, and justice system costs for patients with ADHD without controlling for any variables. The second analysis technique gathered the "excess costs or attributable costs" of ADHD as reported by studies across time. After comparing individuals with and without ADHD, and typically after adjusting for several confounding variables, these expenditures were typically reported.

ADHD relates to significant financial burdens. In the USA, the annual national economic cost of ADHD reached \$US20,273.01 million, as reported by a study that calculated total expenses including direct costs, indirect costs, and costs for the judicial and education systems. This estimated cost as a percentage of GDP was 0.10% ¹⁴. While national annual estimates based on marginal costs were \$US966 million, these estimated costs as a share of Gross domestic product (GDP) were 0.09% In the United States of America (USA) ¹³.

In the European Union, one study calculated costs for the United Kingdom (UK), France, Denmark, and the Netherlands. Excessive direct, indirect, and expenses to the judicial and education systems were reported in the study, totaling \$US325.14 million to \$US3767.62 million. For Denmark, France, the Netherlands, and the UK, this estimated cost as a percentage of GDP was 0.09%, 0.14%, 0.11%, and 0.13%, respectively ¹⁴.

- **Direct medical cost**

In Germany, a study reported that healthcare expenses for those with ADHD are much greater than those of the reference group without ADHD. The average annual excess care costs for ADHD patients are €1549 for females and €1467 for males. In addition, compared to the reference group, ADHD patients experience SUD, obesity, and mood and anxiety disorders considerably more frequently. As a result, there is a significant cost disparity between individuals with ADHD and comorbidity and those who do not have ADHD but have the same illness ¹².

- **Functional Consequences of Attention-Deficit/Hyperactivity Disorder**

ADHD is linked to worse academic achievement and school performance, people with ADHD typically have worse educational attainment, and lower Intelligence Quotient (IQ) scores than their peers. While peer rejection and, to a lesser extent, accidental damage is most prominent with marked symptoms of hyperactivity or impulsivity, academic deficiencies, school-related issues, and peer neglect appear to be most connected with heightened symptoms of inattention. Others frequently see insufficient or inconsistent self-application to tasks that call for persistent effort as laziness, irresponsibility, or a refusal to participate ⁴. Young individuals with ADHD have unstable employment. Adults with ADHD had worse occupational achievement, lower attendance rates, and greater unemployment rates ¹⁵.

- **Criminal behavior:**

Adults with ADHD frequently engage in criminal behavior ¹⁶. Numerous studies have found links between criminal records and antisocial behavior and ADHD severity ¹⁷. Rule-breaking behaviors, delinquency, crime, and recidivism are all linked to ADHD, as is having court engagement at a young age ¹⁸.

The prevalence of criminal conviction was high for both genders compared to the prevalence rates reported in the general population. Criminal conviction was associated with the severity of hyperactivity-impulsivity, The prevalence of

Criminal conviction was 11.7% in women and 24.5% in men, which is considerably higher than the corresponding 1 and 5% rates for women and men in the general Norwegian population ¹⁶.

- **Parental affection:**

Every child with special needs engenders a family with special needs, mothers of children with ADHD frequently struggle with stress, despair, social isolation, and self-blame. According to a study conducted in Saudi Arabia, mothers of children with ADHD had much more severe depression than mothers in the control group. Mothers with children with ADHD displayed greater levels of anxiety and depression. Compared to the control group, mothers of ADHD children had a 40% greater incidence of depression ¹⁹.

- **Increased Risk of Injury:**

According to research, ADHD positively correlates with emergency services, hospitalization, and medical claims for injuries ²⁰. Children and adults with ADHD are more likely to experience trauma and go on to acquire posttraumatic stress disorder. Drivers with ADHD commit more infractions and accidents on the road. Because of accidents and injuries, people with ADHD have a higher total death rate than the general population ⁴.

Clinical Presentations and Diagnosis of ADHD

Three presentations of the disease are defined by the DSM-5 criteria: predominantly hyperactive-impulsive, predominantly inattentive, and combined presentation. The DSM-5 criteria identify two dimensions of symptoms, namely inattention and hyperactivity/impulsivity. According to earlier research, combined and predominantly inattentive presentations are the most frequently seen ²¹.

Clinical evaluation is necessary for the diagnosis of ADHD, which is based on diagnostic classification systems, specifically the Diagnostic and Statistical Manual of Mental Disorders and the International Classification of Diseases 11th revision. While the ICD-11 has transitioned to a prototype presentation, the DSM-5 approach is still largely based on criteria. In this context, ICD-11 mainly depends on the description of key components of the most typical presentations, whereas DSM-5 gives criteria to decide whether the patient qualifies for the diagnosis ²².

- **ADHD severity scale** ⁴:

The severity of ADHD ranges from mild to moderate to severe:

- **Mild:** Few, if any, additional symptoms beyond those needed for diagnosis are present, and symptoms only slightly hinder social or occupational functioning.
- **Moderate:** Present symptoms or functional impairment ranging from "mild" to "severe".
- **Severe:** More symptoms than necessary to make the diagnosis are present, or there are numerous very severe symptoms, or the symptoms significantly hinder social or occupational functioning.

- **Course Features** ²³:

Nearly half of all kids who are diagnosed with ADHD will still show symptoms as they get older. ADHD symptoms tend to remain stable throughout adolescence, with about one-third of those diagnosed as children still experiencing impairment in adulthood. Even though hyperactive symptoms lessen in severity as people age and become adults, problems with inattention, impulsivity, and restlessness can still arise.

- **Diagnostic Markers** ⁴:

No biomarker can diagnose ADHD. Even though ADHD has been linked to the increased power of slow waves (4-7 Hz "theta") as well as decreased power of fast waves (14-30 Hz "beta"); A further review showed no differences in theta or beta power in either children or adults with ADHD compared to control participants.

Management of ADHD

Current clinical guidelines advise an individualized multimodal and interdisciplinary treatment approach. A framework of pharmaceutical and/or nonpharmacological interventions that consider the patient's age, the intensity of their symptoms, and their unique demands should be constructed based on thorough psychoeducation ²⁴. Multimodal treatment techniques also advocate a systematic adaptive process that mixes various treatment modalities in accordance with the needs and circumstances of the patient and family ²⁵.

1. Pharmacological Approaches:

a) Starting Medication ²⁶:

Before starting any medication, the following factors should be considered: the child's medical history, as well as possibly the parents' medical histories, any current medications, the child's height and weight, baseline pulse and blood pressure, a cardiovascular assessment, and an electrocardiogram if the treatment could affect the QT interval. A cardiology expert's opinion should be sought before initiating medication for ADHD if there is a history of congenital heart disease, previous cardiac surgery, or a history of sudden death in a first-degree relative under the age of 40 years, or if the blood pressure is consistently higher than the 95th centile for age and height for children and young people.

b) Age-Specific Needs:

Based on NICE recommendations. Children under the age of five should be distinguished from schoolchildren. Parent or career training programs are always the first-line therapies for children under 5 years of age. Medications can be administered to children with ADHD under the age of five; only after receiving a second professional opinion ²⁷. For kids older than 5, it's important to provide advice on parenting techniques, and intermediary communication with schools, colleges, or universities if the parent gives permission ²⁷. After implementing and evaluating environmental changes, children and adolescents aged 5 and older should only be prescribed medication if the ADHD symptoms significantly impair at least one life domain ²⁶.

c) Pharmacological treatments/drug options:

In short-term trials, the pharmaceutical choices for treating ADHD have substantial effect sizes and generally good tolerability ²⁸.

d) Selection of Pharmacotherapy:

ADHD medications are categorized into two categories: Stimulants (or psychostimulants) and non-stimulants, for each category there are a variety of formulations, delivery methods, and pharmacokinetic profiles to choose from ¹.

1. Psychostimulants:

Psychostimulants, methylphenidate, and amphetamine-based formulations were originally used on children in the 1930s and are still the first-line treatment for ADHD symptoms ¹.

Methylphenidate's mechanism of action involves inhibition of the dopamine and norepinephrine transporters, activation of the serotonin type 1A receptor, and redistribution of the vesicular monoamine transporter. Amphetamine, on the other hand, Amphetamine, causes a blockade of dopamine and norepinephrine transporters, vesicular monoamine transporter 2, and monoamine oxidase activity ²⁹.

In several clinical trials, psychostimulants' effectiveness in lowering symptoms of the disorder throughout treatment has been demonstrated. Additionally, research suggests that psychostimulants lower the incidence of emergency hospital admission for trauma ³⁰ and unintentional accidents ³¹.

Regarding side effects, long-term stimulant use affects growth, particularly the height and weight gain rate. Reduced appetite, a common adverse effect of stimulant therapy, undoubtedly plays a significant part in this. Other common side effects include difficulty sleeping, elevated heart rate and blood pressure, headaches, agitation, and stomach pain.

2. Non-stimulant medications:

Non-stimulant drugs often only treat patients who do not respond well to stimulant formulations or who have unpleasant side effects because they have smaller responses and effect sizes compared to stimulants. The norepinephrine transporter inhibitor atomoxetine and the α -2 agonists guanfacine and clonidine are examples of non-stimulant drugs. If treatment with stimulants proves ineffective, non-stimulant drugs are typically regarded as second-line remedies ¹.

In child and adolescent clinical trials, atomoxetine's most frequent side effects included nausea, vomiting, exhaustion, decreased appetite, abdominal pain, and somnolence. A higher risk of suicidal ideation during treatment in participants taking atomoxetine was reported ³².

Other non-stimulant ADHD medications include Clonidine and guanfacine which act as agonists at alpha-2 adrenergic receptors; enhancing Noradrenergic

neurotransmission²⁸; are authorized for the treatment of ADHD as monotherapy or as an adjuvant therapy to stimulants.

N.B: The pharmacological treatment plan is frequently adjusted and changed; this is the norm. This may be caused by modifications in the patient's symptomatology or psychosocial environment, but it may simply be the result of natural development, such as a gain in weight³³.

e) Compliance with pharmacological treatment:

Lack of compliance may impede the progress of pharmacological treatment by reducing effectiveness, increasing adverse events, and other related issues³⁴. Medication adherence should be periodically evaluated during treatment, and any possible problems should be openly discussed³⁵.

f) The association between ADHD medication and school performance:

ADHD medication and teacher evaluations were shown to be positively correlated. Three months of treatment considerably reduced the likelihood of becoming ineligible for upper secondary school and was linked to higher grade point totals. Scaling the adjusted estimates to the maximum treatment period of 29 months resulted in a lower risk of not being eligible for upper secondary school³⁶.

2) Nonpharmacological Approaches:

1. Cognitive Behavioral Therapy:

Cognitive behavioral therapy (CBT) is a behavioral intervention that tries to reduce ADHD behaviors or associated issues²⁶. Behavior, parenting abilities, child-parent interactions, and some everyday living skills all benefit from CBT and its more specialized versions, such as training in social skills, planning and organizational skills, and self-management strategies¹⁴. According to a recent meta-analysis, medication and CBT together are more effective than stimulant medicine alone (with an estimated standardized mean difference of 0.5)³⁷.

2. Neuropsychological Treatments:

Cognitive exercises that target cognitive areas like working memory or inhibitory control are carried out repeatedly and with escalating difficulty in cognitive training therapies, whether they are computer-supported or manualized. According to recent

investigations, the evidence base for this form of intervention needs to be stronger³⁸.

Although some "near-transfer" gains in neuropsychological tests that draw on the trained domain, the evidence for "far transfer" to academic performance or the severity of ADHD symptoms is scarce. However, regardless of each participant's unique cognitive challenges, the majority of research used the same type of cognitive training. Additionally, they did not follow domain-specific training recommendations made by theoretically based training principles for the functional rehabilitation of a particular neuropsychological deficiency. Future treatments for ADHD children may benefit more if they mix top-down strategy implementation with repetitive exercise²⁶.

3. Noninvasive Brain Stimulation:

Repetitive transcranial magnetic stimulation (TMS) and transcranial direct current stimulation (tDCS) are among the potential methods to modify cortical activity. These treatments may also be promising in improving clinical and cognitive ADHD symptoms including inattention and impulsivity³⁹.

According to a meta-analysis by⁴⁰, the left or right prefrontal gyrus stimulation may enhance performance in activities requiring inhibition, working memory, or attention. Therapy guidelines do not, however, currently endorse these methods.

4. Alternative Nonpharmacological Treatment Methods

Although there is some evidence that mindfulness training, exercise, and yoga have a good impact on ADHD behavior, this research is currently inconclusive, and these treatments are best thought of as supplemental to other therapies⁴¹.

5. Classroom management of ADHD³:

According to the American Academy of Pediatrics (AAP), any ADHD treatment plan should include the school environment. AAP also suggests behavior therapy provided by teachers.

➤ Behavioral classroom management:

It has been demonstrated that using a teacher-led strategy (Through reward systems or daily report cards) can positively impact students' conduct and raise academic engagement.

➤ **Organizational training:**

Children receiving organizational instruction learn time management techniques, planning strategies, and how to maintain school supplies in an orderly manner to maximize learning and minimize distractions.

- **Classroom management may also include:**

➤ **Environmental modifications:**

refer to the adjustments made to the actual surroundings with the goal of minimizing the effects of an individual's ADHD on their daily activities. These modifications will depend on their unique circumstances. Examples include rearranging seating, altering the lighting and noise level, and maximizing work or education to have shorter focus periods with movement breaks (like using "I need a break" cards) ²⁷.

➤ **Reasonable adjustments:**

relates to education institutions' legal duties to ensure that students with disabilities or physical or mental health issues do not face undue disadvantages in their employment or academic pursuits ²⁷.

Conclusion:

Attention deficit hyperactivity disorder (ADHD) is one of the most common life-span neurodevelopmental conditions, that can impose serious negative impacts on the affected individuals, as well as their families and societies. ADHD consequences range from health affection, academic underachievement, employment instability to financial losses. Diagnosis of ADHD is mainly based on clinical evaluation according to diagnostic criteria and guidelines. Management of ADHD is a multi-modal approach, that includes pharmacological, neuropsychological, and behavioral therapies. The present article recommends multi-sectorial cooperation to decrease consequences of ADHD on affected individuals, families and societies, by providing attention to children's mental well-being through mass media and educational facilities, sharing information about ADHD and other mental issues, early detection and management of ADHD, and other mental health issues, providing a flexible referral system between schools and health insurance hospitals, that allows referral of children identified by teachers as possible ADHD cases, providing support to

families of ADHD children through governmental social services, and conducting further research about the nature, manifestations, diagnosis, and management strategies of ADHD.

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