ATTENTION DEFICIT HYPERACTIVITY DISORDER

IS IT A DISORDER!!!

IPRNworld

ATTENTION DEFICIT HYPERACTIVITY DISORDER: IS IT A DISORDER!!!

ANCC Accredited NCPD Hours: 2 hrs

Target Audience: RN/APRN

NEED ASSESSMENT

Attention-deficit/hyperactivity disorder (ADHD) is a highly heritable neurodevelopmental disorder with an estimated heritability of 70–80%. It is the most common neurodevelopmental disorder in childhood, and research shows that in a significant proportion of individuals, symptoms persist into adulthood. Both in childhood and adulthood, ADHD is associated with substantial comorbidities, including substance use disorders, depression, anxiety, and increased risk of accidents. However, symptoms and comorbidities may fluctuate over time, and the exact predictors of persistence versus remission remain unclear. Additionally, while ADHD was traditionally considered a childhood-onset disorder, recent studies have questioned strict age-of-onset criteria. Given these complexities, a lifespan perspective on ADHD from childhood to old age is crucial for understanding its course and optimizing long-term management.

OBJECTIVES

- Discuss the general aspects of ADHD
- Understand the epidemiology and prevalence of ADHD
- Identify the different risk factors and etiological factors for ADHD
- Understand the neurophysiology and developmental psychopathology of ADHD
- Describe the classification of ADHD
- Discuss the clinical presentation of ADHD and diagnostic criteria for ADHD
- Understand the comorbidities concerning ADHD
- Discuss the various treatment strategies.

GOAL

This article aims to summarize current knowledge on the long-term course of ADHD, focusing on clinical symptom trajectories, cognitive development, treatment effects across the lifespan, and the evolution of comorbidities.

INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD), as defined by the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), and its equivalent in the International Classification of Diseases, 11th Revision (ICD-11), is a childhood-onset neurodevelopmental disorder characterized by persistent symptoms of inattention, impulsivity, and/or hyperactivity. These symptoms must be present for at least six months, manifest across multiple settings, and exceed what is developmentally appropriate for the individual's age and cognitive abilities. A key diagnostic criterion is the presence of clinically significant impairment in psychosocial, academic, or occupational functioning, which must be observed in at least two distinct environments, such as home, school, or the workplace.

ADHD symptoms exist on a continuum within the general population, with varying degrees of severity. While many individuals may exhibit some traits associated with the disorder, only those at the end of this spectrum, where symptoms lead to substantial functional impairment, meet the clinical threshold for diagnosis. The conceptualization of ADHD has evolved, with contemporary research emphasizing its dimensional nature, heterogeneous presentation, and the interplay of genetic, neurobiological, and environmental factors in its aetiology and persistence across the lifespan.

GENERAL ASPECTS OF ADHD ATTENTION-DEFICIT/HYPERACTIVITY DISORDER AS A NEURODEVELOPMENTAL CONDITION

Attention-deficit/hyperactivity disorder (AD HD) is a neurodevelopmental condition that typically emerges in childhood or early adolescence and follows a trait-like course across the lifespan. It is characterized by developmentally inappropriate inattention and/or hyperactivity-impulsivity levels that significantly impair an individual's academic, occupational, and social functioning. At the same time, ADHD is sometimes misconceived as a modern phenomenon; historical descriptions of similar symptomatology date back to the late 18th century.

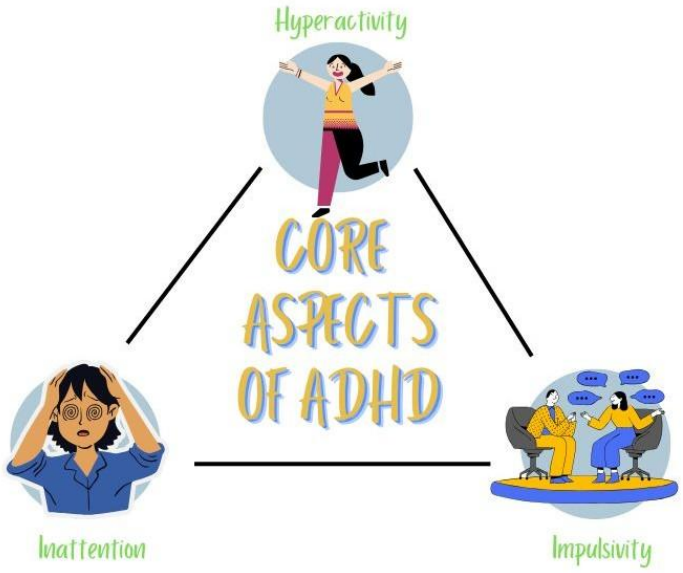
Initially, ADHD was predominantly recognized in school-aged boys; however, subsequent research has highlighted its presence across genders, with females often exhibiting a less overt but equally impairing symptom profile, leading to underdiagnosis and misdiagnosis. Epidemiological studies over the past few decades have demonstrated that ADHD is prevalent across diverse populations and significantly impacts productivity, life expectancy, and overall quality of life.

A major paradigm shift occurred in the late 20th century when robust evidence confirmed that ADHD persists into adulthood in a substantial proportion of individuals. This finding underscored the necessity of adopting a lifespan perspective, encompassing the disorder's evolving clinical presentation, comorbidities, and underlying neurobiological mechanisms. Continued research in this area remains critical to improving diagnostic accuracy, treatment strategies, and long-term outcomes for affected individuals.

The three main core features of Attention-Deficit/Hyperactivity Disorder (ADHD), as defined by the DSM-5, are:

1. Inattention

- Difficulty sustaining attention in tasks or play activities
- Frequent careless mistakes, seeming not to listen when spoken to
- Struggles with organization, forgetfulness, and avoiding tasks that require sustained mental effort



2. Hyperactivity

- Excessive motor activity (e.g., fidgeting, inability to stay seated)
- Inappropriate running or climbing, especially in situations where it is not suitable
- Often appears to be "on the go" or acts as if "driven by a motor"

3. Impulsivity

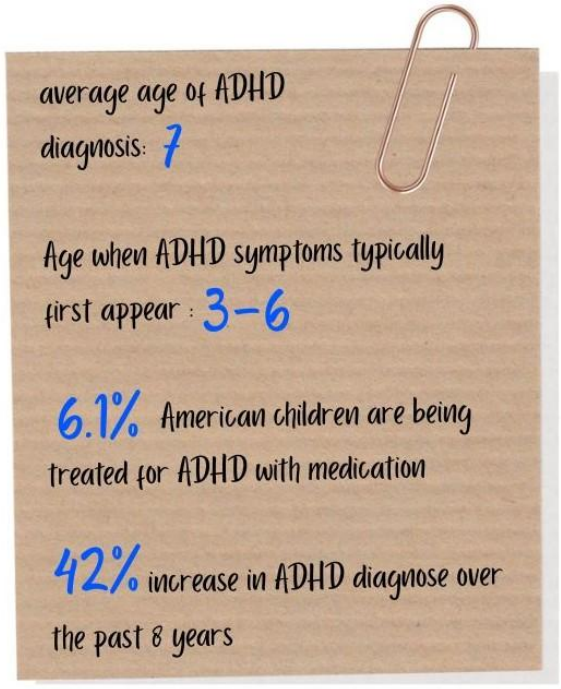
- Difficulty waiting for their turn
- Blurting out answers or interrupting others
- Acting without considering consequences, which can lead to risky behaviours

These features may present differently across the lifespan and between individuals, with some showing predominantly inattentive symptoms, others predominantly hyperactive/impulsive

symptoms, or a combination of both (combined presentation).

EPIDEMIOLOGY OF ADHD

Attention-deficit/hyperactivity disorder (ADHD) is one of the most prevalent neurodevelopmental disorders of childhood and adolescence. Based on diagnostic criteria from the **DSM-IV**, global epidemiological studies estimate the prevalence of ADHD in youth to be approximately **5.3%**, a figure that has remained stable over the past three decades. In contrast, the more stringent criteria of **ICD-10**, which previously classified the condition as hyperkinetic disorder (HKD), yield lower prevalence estimates, typically in the range of **1–2%**. The transition to **ICD-11** has aligned its criteria more closely with those of **DSM-5**, which may lead to higher international diagnostic consistency moving forward.



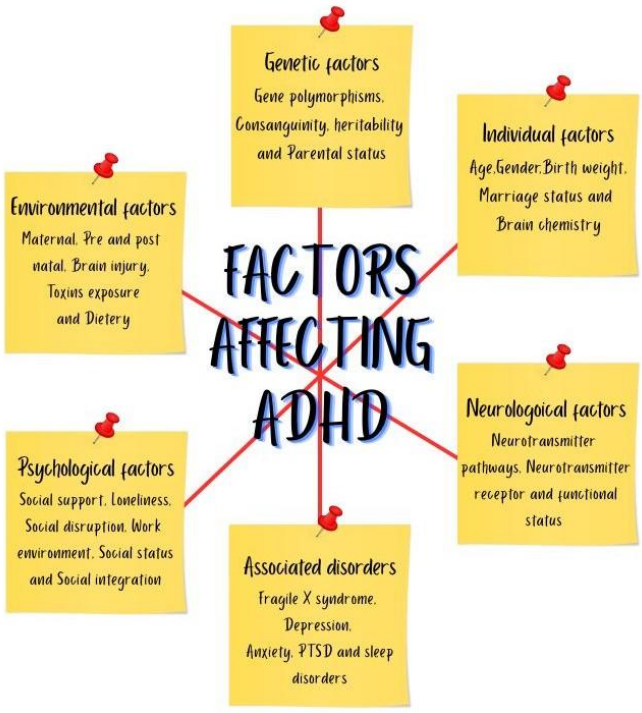
In adults, ADHD persists in a significant subset of individuals, with population-based studies estimating a prevalence of approximately **2.5%** under DSM-5 criteria. While ADHD is more commonly diagnosed in males than females, this sex disparity is more pronounced in clinical populations than in epidemiological samples, likely reflecting referral biases and differing symptom presentations across genders.

ADHD is also associated with **lower socioeconomic status**, a relationship that may be influenced by both environmental and genetic factors, as well as disparities in access to healthcare and educational support.

Although diagnosis rates have increased substantially in many countries, reaching approximately **4% or more** among children

and adolescents in some regions, this rise is not attributed to a true increase in the disorder's prevalence. Instead, it reflects **greater awareness, evolving diagnostic practices, and improved access to mental health services**. Notably, the global population-based prevalence of ADHD has remained consistent, underscoring the importance of distinguishing between diagnostic trends and epidemiological reality.

RISK FACTORS /ETIOLOGICAL FACTORS FOR ADHD



Genetic Risk Factors for ADHD

Attention-deficit/hyperactivity disorder (ADHD) is one of the most heritable psychiatric conditions, with robust evidence indicating a strong genetic basis. Family studies demonstrate that first-degree relatives of individuals with ADHD have a five- to tenfold increased risk of developing the disorder compared to the general population.

Twin studies have consistently reported heritability estimates ranging from 70% to 80%, suggesting that the majority of the variance in ADHD risk is attributable to genetic factors. However, gene–environment interactions play a critical role, wherein environmental exposures can influence gene expression through epigenetic mechanisms, such as DNA methylation.

The remaining variance in ADHD risk is attributed primarily to non-shared environmental influences, including pre-, peri-, and postnatal factors (e.g., low birth weight, prenatal toxin exposure, early-life stress) that are not experienced equally by siblings. In contrast, shared environmental factors—those common to both siblings—appear to exert a relatively minor effect.

Recent genome-wide association studies (GWAS) have identified multiple common genetic variants (with minor allele frequencies >5%) associated with ADHD. While these common variants individually confer only small increases in risk, collectively they explain approximately 40% of the heritable component of ADHD. Ongoing research is also investigating the role of rare variants and copy

number variants (CNVs), which may contribute to more severe phenotypes or comorbid presentations.

Additionally, ADHD symptoms frequently occur in the context of certain neurogenetic syndromes, such as fragile X syndrome, tuberous sclerosis complex, and Williams–Beuren syndrome, highlighting the relevance of broader genetic mechanisms in ADHD pathophysiology. [6, Rank 3]

Environmental Risk Factors for ADHD

A growing body of epidemiological research has identified a range of environmental factors that are associated with increased risk for attention-deficit/hyperactivity disorder (ADHD). These factors span the pre-, peri-, and postnatal periods, with particular emphasis on exposures during critical phases of neurodevelopment.

Prominent prenatal and perinatal risk factors include maternal stress during pregnancy, tobacco and alcohol use, low birth weight, and premature birth. These factors have been associated with disruptions in foetal brain development and are recurrently implicated in observational studies of ADHD risk.

Environmental neurotoxins—such as lead, organophosphate pesticides, and polychlorinated biphenyls (PCBs)—have also been linked to increased ADHD symptomatology. These agents may interfere with dopamine signalling, neuronal growth, or synaptic plasticity during critical developmental windows. However, the evidence supporting a direct causal role remains limited.

In addition, adverse psychosocial environments, including early-life deprivation, inconsistent parenting, or maternal hostility, have been associated with a higher likelihood of persistent and severe ADHD symptoms. Notably, these associations are complex and may be bidirectional. For instance, while negative parent–child interactions in early childhood are often a consequence of the child's ADHD-related behaviours, longitudinal studies suggest that persistent maternal hostility may exacerbate symptom severity over time.

Dietary factors have also been investigated, including low levels of essential fatty acids and exposure to artificial food additives. Although some evidence supports the role of nutrition in modulating symptom expression, the overall contribution of dietary factors to ADHD risk appears modest and is not yet well-defined.

Importantly, the causal status of many of these environmental risk factors remains uncertain. These exposures are not randomly distributed across the population and are often entangled with genetic predispositions and socioeconomic factors. In some cases, children with a genetic liability to ADHD may be more likely to encounter specific environments—a phenomenon known as gene–environment

correlation. Thus, observed associations may reflect confounding, selection effects, or even reverse causality, rather than direct environmental causation.

Neurobiological Basis of ADHD: Structural, Functional, and Etiological Insights

1) Structural and Functional Brain Abnormalities

Neuroimaging studies have consistently revealed **subtle but significant structural and functional brain abnormalities** in individuals with attention-deficit/hyperactivity disorder (ADHD). On average, **global brain volume is reduced by approximately 3–5%**, with **Gray matter** being more prominently affected than white matter. These reductions are especially pronounced in **key regions involved in executive function and attention regulation**, including the **prefrontal cortex**, **basal ganglia**, and **cerebellum**. Notably, **volume reductions in these areas are often correlated with symptom severity**, particularly in younger populations.

A hallmark finding in developmental imaging studies is a **delay in cortical maturation**, especially within **prefrontal regions** responsible for inhibitory control, planning, and attention. While cortical thinning is part of typical development, this process appears to occur **later and more slowly** in children with ADHD. Importantly, the **persistence of ADHD symptoms into adulthood** has been associated with the continued presence of these **neuroanatomical deviations**, whereas individuals who show symptom remission often display more normalized trajectories of brain development.

However, the **degree of abnormality varies** significantly across individuals, brain regions, and subtypes of ADHD, reflecting the **heterogeneity** of the disorder.

2) Pathophysiological Considerations and Etiological Complexity

Despite substantial advances, the **pathophysiological mechanisms underlying ADHD remain incompletely understood**. The current consensus supports a **multifactorial model**, wherein **genetic predispositions** interact with **early environmental influences** to shape the developing brain in ways that increase susceptibility to ADHD.

ADHD exhibits high **etiological heterogeneity**:

- **Each genetic or environmental factor** tends to account for only a **small proportion of the overall risk**, contributing weak effects or affecting only a subset of individuals.

- Many identified **risk factors are not specific** to ADHD and are also associated with an increased risk for other **neurodevelopmental and psychiatric conditions** (e.g., autism, mood disorders).
- Some of these risk factors are also linked to **subclinical ADHD-like traits** in the general population, reinforcing the view that ADHD reflects the **end of a continuously distributed spectrum** of attentional and behavioural traits.

This **dimensional perspective** aligns with findings from neuroimaging, cognitive neuroscience, and psychiatric epidemiology, which together suggest that ADHD is best conceptualized as a **complex, heterogeneous disorder** rooted in widespread—albeit subtle—**neurodevelopmental differences**.

Neuropsychology of ADHD

Neuropsychological research provides critical insight into the connection between **biological underpinnings** and the **behavioural manifestations** of attention-deficit/hyperactivity disorder (ADHD). Historically, ADHD was conceptualized primarily as a disorder of **cognitive dysregulation**, with symptoms attributed to deficits in higher-order executive functions such as **planning**, **inhibitory control**, and **self-regulation**.

Children with ADHD have consistently demonstrated **impaired performance on standardized neuropsychological tasks** when compared to age- and IQ-matched control groups. For example, on tests requiring **response inhibition**, such as those involving matching familiar figures or suppressing impulsive choices, children with ADHD tend to exhibit **increased impulsivity**, **reduced accuracy**, and **elevated error rates**. These findings support the hypothesis that the disorder involves a core deficit in executive functioning, particularly in domains related to **behavioural inhibition**, **sustained attention**, and **cognitive flexibility**.

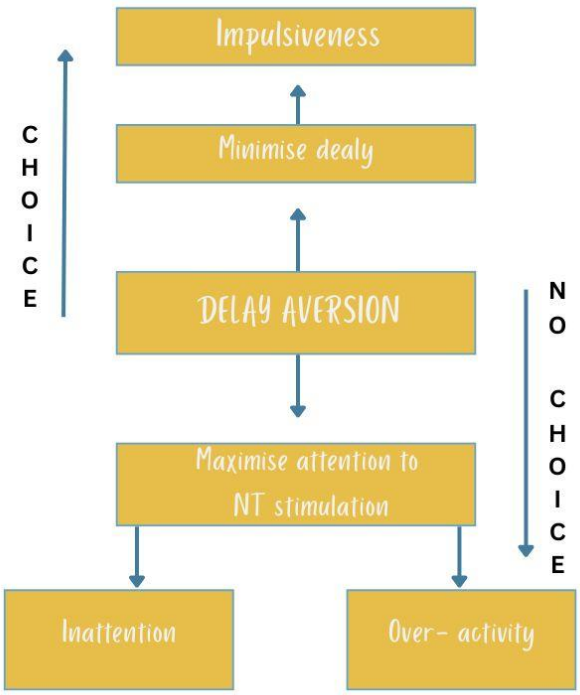
Although this cognitive model explains many features of the disorder, it is now understood that **not all individuals with ADHD** show uniform deficits on neuropsychological assessments. This suggests that **multiple neuropsychological pathways** may contribute to the disorder, with **executive dysfunction representing only one component** of a broader and more heterogeneous neurocognitive profile.

Cognitive Dysregulation and Delay Aversion in ADHD

Traditionally, ADHD has been conceptualized as a disorder of **cognitive dysregulation**, with

particular emphasis on deficits in **inhibitory control**. This model suggests that the relationship between neurobiological abnormalities and observable behaviour in individuals with ADHD is mediated by impairments in executive functions such as response inhibition, planning, and self-monitoring. Supporting this view, numerous neuropsychological studies have demonstrated that children with ADHD exhibit significantly more **impulsive responses and higher error rates** on tasks requiring sustained attention and self-regulation compared to neurotypical peers. However, alternative theoretical perspectives have emerged, challenging the notion that ADHD-related behaviours stem solely from cognitive dysfunction. One such perspective frames ADHD as a **motivational style**, emphasizing the individual's aversion to delay rather than a core deficit in cognitive control. According to this model, behaviours traditionally interpreted as impulsive may reflect **strategic attempts to avoid delays**, particularly in task environments where quicker responses result in faster task completion.

Evidence supporting this view comes from studies comparing performance under different task constraints. In standard, self-paced paradigms—where each response leads directly to the next trial—children with ADHD tend to respond impulsively, completing tasks more quickly, but with decreased accuracy. However, when the same tasks are administered under fixed-time constraints, where rapid responses do not reduce overall delay, **performance differences between children with and without ADHD diminish significantly**. These findings led to the formulation of the **Delay Aversion Hypothesis**, which posits that individuals with ADHD are particularly sensitive to delay and will engage in behaviours aimed at minimizing it.



The influence of delay aversion on behaviour appears to be moderated by the level of control the child has over their environment. When able to influence outcomes (e.g., skipping a line to reach a desired activity sooner), impulsive behaviour may be a means of escaping perceived delays. In contrast, in structured settings where control is limited (e.g., classroom learning), children may resort to

alternative coping strategies such as **daydreaming** (manifesting as inattention) or **fidgeting** (manifesting as hyperactivity) to distract themselves from the passage of time.

In this framework, the relationship between neurobiology and behaviour is still preserved but is mediated through **motivational processes**, specifically, a heightened sensitivity to delay, rather than executive dysfunction alone. This approach broadens our understanding of ADHD by acknowledging the **interaction between cognitive, motivational, and environmental factors** and supports a more nuanced, individualized view of symptom expression.

Prenatal Risk Factors and ADHD

The role of **prenatal and perinatal factors** in the development of attention-deficit/hyperactivity disorder (ADHD) has been widely studied, though findings remain somewhat inconsistent. Some studies have found **no significant increase** in pregnancy or birth complications among children diagnosed with ADHD compared to typically developing peers. Conversely, other investigations have reported a **slightly elevated prevalence** of adverse obstetric events, such as **abnormally short or prolonged labour, foetal distress, instrumental (e.g., forceps) delivery, and maternal toxaemia or eclampsia**, in individuals later diagnosed with ADHD.

While the overall incidence of **prematurity or low birth weight** may not be disproportionately higher among all children with ADHD, research suggests that infants born **very prematurely or with significantly low birth weight** are at heightened risk for later development of **hyperactivity and ADHD-related symptoms**. This supports the notion that specific prenatal complications may contribute to **neurodevelopmental vulnerability**, even if not universally present in all cases.

Among the more consistently identified prenatal risk factors is **maternal smoking during pregnancy**, which has been repeatedly associated with an increased likelihood of ADHD onset in early childhood. Additionally, **maternal stress during pregnancy** has been implicated as a significant contributor to ADHD risk. Notably, **parental smoking during pregnancy** has also been linked to **reduced responsiveness to behavioural interventions** aimed at managing ADHD symptoms in school-aged children.

In a study by Hartsough and colleagues, **neonatal anthropometric measurements** such as **reduced head circumference** and a **lower head circumference-to-body length ratio** were predictive of later behavioural symptoms of ADHD. However, several other prenatal and perinatal variables—including **gestational age, maternal age, prenatal**

tobacco or alcohol use, pre-pregnancy body mass index (BMI), parity, family income, child's BMI at age five or six, and gender—did not show significant predictive value for ADHD symptoms at follow-up.

These findings underscore the **complex and multifactorial nature** of ADHD aetiology, wherein certain prenatal exposures and early biological indicators may elevate risk, but do not operate in isolation or with uniform impact across populations.

Environmental Influences on ADHD

Environmental influences have been extensively studied in the aetiology and course of **attention-deficit/hyperactivity disorder (ADHD)**. Contemporary understanding supports a **gene–environment interaction model**, whereby **genetic vulnerability interacts with environmental stressors** to shape the manifestation and severity of ADHD symptoms. In this framework, children with a genetic predisposition for ADHD are more likely to exhibit symptoms when exposed to environments characterized by **high levels of psychosocial stress**, including **chaotic, inconsistent, or harsh parenting practices**.

Among the most compelling evidence for environmental contributions are findings from **intervention studies**, which demonstrate that **targeted parent training programs** can lead to significant reductions in ADHD symptoms. These improvements underscore the importance of the **environmental context** but should not be misinterpreted as parental fault. Rather, the dynamic between parent and child is best conceptualized through an **interactionist lens**: the child's challenging behaviour may influence parenting style, and vice versa, creating a **bidirectional cycle** of reinforcement.

Research examining **parent-child interactions** has revealed that children with ADHD tend to be **less compliant, less attentive, and more hyperactive** than neurotypical peers. Correspondingly, **parents of children with ADHD**, particularly mothers, often demonstrate **more negative, controlling, intrusive, and disapproving behaviours**, and are **less rewarding and responsive** in interactions. These patterns are not exclusive to mothers; studies also show that **fathers of children with ADHD** display increased **demandingness and power-assertiveness**, contributing further to the familial stress dynamic.

Furthermore, research highlights **gender differences** in parental responses. For example, mothers may issue **more commands and rewards** to sons than daughters with ADHD, but also exhibit **greater emotional reactivity and reduced warmth** in these interactions. Interestingly, parental conflict can escalate when **fathers become involved in**

mother–child dynamics, particularly among boys with ADHD, suggesting that **triadic interactions** may intensify familial stress.

It is also important to consider the role of **parental ADHD**. ADHD frequently runs in families, and **children with ADHD are more likely to have a parent with the disorder**. Parental ADHD symptoms—such as impulsivity, inattention, and emotional dysregulation—can impair **effective parenting practices**, such as consistent discipline, monitoring, and emotional attunement. Research indicates that **parental ADHD** is associated with **diminished use of constructive parenting techniques** and may even interfere with the **efficacy of behavioural interventions**, especially among preschool-aged children.

In sum, while **environmental factors alone do not cause ADHD**, they play a critical role in modulating its **expression, severity, and developmental trajectory**, particularly through complex, bidirectional interactions between **child characteristics and parenting practices**.

Exposure to Environmental Toxins

Environmental toxins, particularly **heavy metals and industrial pollutants**, have been investigated as potential contributory factors in the development of **attention-deficit/hyperactivity disorder (ADHD)**. A broad spectrum of **neurotoxic substances** prevalent in the modern environment has been shown to adversely affect the **central nervous system (CNS)**. These effects range from **overt neurodevelopmental damage** to more subtle disruptions in **cognition, behaviour, and motor regulation**, particularly in young children.

Among the most well-studied environmental toxins is **lead**, which continues to pose a public health concern despite regulatory efforts to reduce exposure. Elevated lead levels—whether through **acute or chronic exposure**—have been associated with **lasting neurological sequelae**, including **attention deficits, increased emotional reactivity, and behavioural dysregulation**. Other toxic metals, such as **arsenic, mercury, aluminium, and cadmium**, similarly exhibit neurotoxic potential and have been linked to abnormalities in **perception, motor coordination, and executive function**. Additionally, **organohalide pesticides, herbicides, fumigants**, and various **aromatic and aliphatic solvents** are recognized for their adverse impacts on the developing brain.

In epidemiological studies, a **modest but consistent correlation** has been found between **elevated body lead burden** and the presence of **ADHD symptoms**, particularly hyperactivity and impulsivity. However, this relationship is not deterministic. For example,

in one study, fewer than **38% of children with high lead exposure** were rated as hyperactive on teacher-assessed behavioural scales. This finding indicates that while lead may **increase the risk** for attentional and behavioural problems, it is **neither necessary nor sufficient** to cause ADHD in most cases.

Furthermore, the majority of children diagnosed with ADHD **do not exhibit clinically elevated lead levels**, underscoring the **multifactorial aetiology** of the disorder. The evidence suggests that environmental toxins may act as **modifiers or amplifiers** of underlying genetic or neurobiological vulnerabilities rather than as **primary causal agents**.

DEVELOPMENTAL PSYCHOPATHOLOGY OF ADHD

ADHD presents with a **developmentally dynamic symptom profile**, where the severity and visibility of symptoms vary depending on **environmental demands and life context**. Symptoms are typically first identified in settings that require sustained attention, impulse control, and behavioural regulation, such as classrooms, during homework, or in structured group activities. However, in children under the age of four, **excessive motor activity** is often difficult to distinguish from normal developmental variation.

Importantly, **situational modifiers**—such as novelty, strong external structure, motivation, or the prospect of a reward—can temporarily **suppress symptoms**. However, these effects are not enduring, and a **lack of observable symptoms in a limited setting** does not exclude an ADHD diagnosis.

As children enter elementary school, **inattentiveness** often becomes more pronounced and functionally impairing due to increasing **cognitive and social demands**. While **hyperactivity** may diminish in adolescence, it often transitions into an **internal sense of restlessness**. Core features like **inattention, impulsivity, and poor planning abilities** frequently persist into adulthood. Adult presentations are commonly accompanied by **emotional dysregulation**, including irritability, low frustration tolerance, and mood instability.

Longitudinal studies reveal a **gradual decline in core ADHD symptoms** across the lifespan. Approximately **5–15% of individuals** continue to meet full diagnostic criteria in adulthood, yet **up to 70%** experience persistent symptoms or functional impairments. Variability in these findings is largely attributed to **methodological differences** across studies. In many adults, **comorbid psychiatric conditions**—such as mood or conduct disorders—may dominate the clinical presentation.

A **poor long-term prognosis** is more likely in

the presence of:

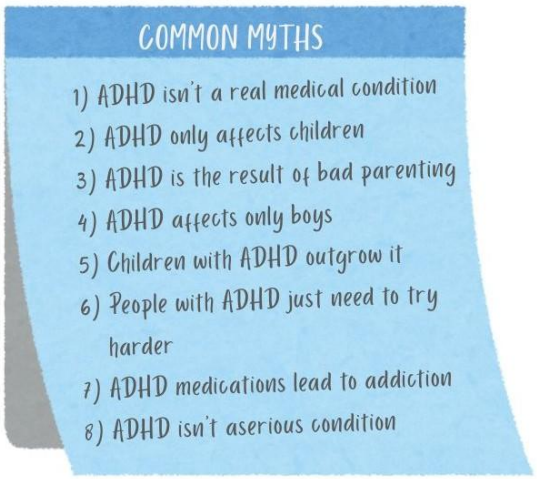
- A **family history** of ADHD
- **Unfavourable psychosocial conditions** (e.g., early childhood neglect, parental psychopathology)
- **Severe early symptoms**
- **Comorbid disorders**, particularly **conduct** and **depressive disorders**

ADHD is strongly associated with **reduced psychosocial functioning** and **impaired quality of life**. Children with ADHD are significantly less likely to complete higher education and, on average, attain **lower socioeconomic status**. Their interpersonal relationships—with parents, siblings, peers, and romantic partners—are frequently marked by **conflict**.

Moreover, individuals with ADHD face a:

- **2–3-fold increased risk** of delinquency
- **6-fold higher risk** of suicidal ideation before age 13
- **4-fold increased lifetime risk** of suicide
- **50% higher all-cause mortality rate**, largely due to **accident proneness**, particularly road traffic accidents

While ADHD is, by definition, a **neurodevelopmental disorder** with **childhood onset**, emerging longitudinal data suggest that some individuals may only manifest clinically significant symptoms in **adulthood**. This delayed emergence may reflect the protective effect of early environmental supports, with symptoms surfacing as **functional demands** increase later in life.



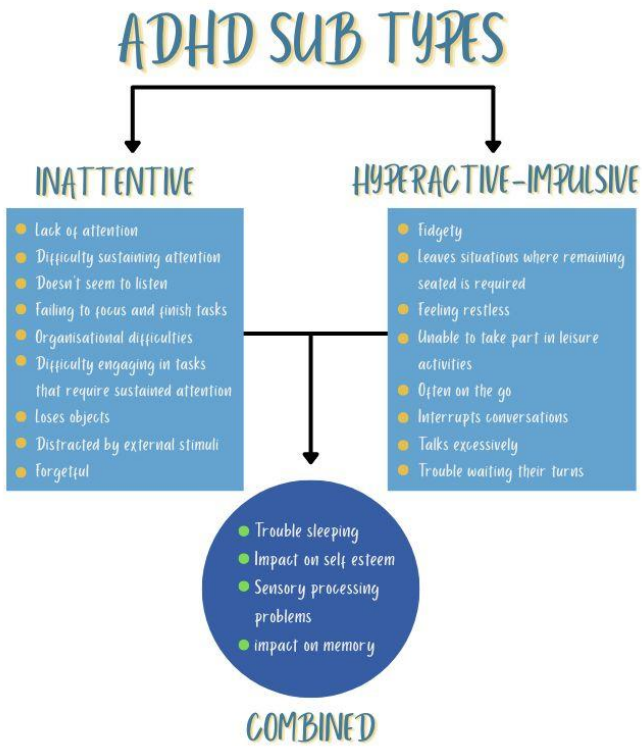
CLASSIFICATION OF ADHD

The two most commonly used classification systems worldwide, the ICD-10 and the DSM-5, are broadly consistent in their operationalization of the various symptoms of ADHD, but differ concerning subtypes and additional criteria. The "subtypes" defined in the DSM-IV have been attenuated to "presentations" in the DSM-5, due to their temporal instability and frequent developmentally dependent changes from one category to another.

The DSM-5 is the first classification system to define specific features of ADHD in adults, reducing the number of symptoms necessary for diagnosis from the age of 17, since functional impairment can persist or worsen with age despite an age-dependent reduction of symptoms. Moreover, the age of onset criterion

has been raised to 12 in the DSM-5, as an older age of onset (between 7 and 12 years) was found to show no effect on clinical manifestation, symptom severity, nature and extent of comorbid disorders, neuropsychological findings and functional impairment, progression or treatment response [3, Rank 5]

Attention-Deficit/Hyperactivity Disorder (ADHD) is delineated in both the **Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)**, and the **International Classification of Diseases, 11th Revision (ICD-11)**. While both frameworks aim to standardize the diagnosis of ADHD, they exhibit distinct differences in their criteria and classifications.



1) Symptom Criteria:

- **DSM-5:** Identifies nine symptoms each for inattention and hyperactivity/impulsivity.
- **ICD-11:** Specifies 11 symptoms for both inattention and hyperactivity/impulsivity.
- **Diagnostic Thresholds:**
- **DSM-5:** Sets explicit thresholds for diagnosis, requiring six or more symptoms in either the inattention or hyperactivity/impulsivity categories for individuals up to age 16, and five or more for those aged 17 and above.
- **ICD-11:** Does not define a specific number of symptoms required for diagnosis, affording clinicians greater discretion
- **Symptom Partitioning:**
- **DSM-5:** Combines hyperactivity and impulsivity into a single category.
- **ICD-11:** Maintains distinct categories for hyperactivity and impulsivity symptoms.
- **Presentations and Subtypes:**
- **DSM-5:** Outlines three presentations of ADHD:
  - Predominantly Inattentive Presentation
  - Predominantly Hyperactive-Impulsive Presentation
  - Combined Presentation
- **ICD-11:** Recognizes similar presentations and includes two additional categories:
  - Other Specified Presentation
  - Presentation Unspecified

2) Age of Onset:

- **DSM-5:** Specifies that several symptoms

must have been present before age 12.

- **ICD-11:** Indicates that significant inattention and/or hyperactivity-impulsivity symptoms typically emerge by early to mid-childhood, without stipulating an exact age of onset.

These distinctions underscore the efforts of both classification systems to balance standardized diagnostic criteria with clinical flexibility in addressing the complexities of ADHD diagnosis.

THE CLINICAL PRESENTATION OF ADHD

The clinical presentation of Attention-Deficit/Hyperactivity Disorder (ADHD) is highly heterogeneous, encompassing a broad spectrum of symptom severity, functional impairments, and co-occurring conditions. Symptoms may partially overlap with those seen in other psychiatric or somatic disorders and can even emerge transiently in response to physiological states, such as acute stress or sleep deprivation. This diagnostic complexity highlights the necessity of clearly defined criteria, including age of onset, symptom persistence, context variability, symptom count thresholds, and exclusion of alternative explanations.

Despite several revisions to diagnostic frameworks over the years, the core clinical features of ADHD have remained largely consistent. The **Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)**, stipulates that **several symptoms must be present before the age of 12** and that these symptoms should be evident across **two or more settings** (e.g., home, school, work). This reflects the developmental and pervasive nature of the disorder.

DSM-5 (APA ,2013)	ICD 11 (WHO ,2022)
Core symptoms domain: 1)Inattention 2)Hyperactivity 3)Impulsivity	Same domain: 1)Inattention 2)Hyperactivity 3)Impulsivity
Subtypes/Presentations: 1)Predominantly inattentive presentation 2)Combined presentation	Subtypes/Presentations: No formal subtypes instead severity and predominant features are noted descriptively
Symptom threshold (Children): ≥6 symptoms in either or both domains for at least 6 months	Symptom threshold (Children): Symptoms must be clearly present and developmentally inappropriate for at least 6months
Functional Impairment: Symptoms must cause clinically significant impairment in social, academic or occupational	Functional Impairment: Same requirement for observable functional impairment across multiple stages
Contextual Settings: Symptoms must be present in ≥2 settings (e.g., home, school, work)	Contextual Settings: Symptoms must be evident across multiple settings or situations

It is important to recognize that ADHD does not present uniformly across individuals. The degree of functional impairment is influenced not only by symptom type and severity but also by contextual, environmental, and individual factors. Therefore, clinical assessment must go beyond symptom counts, considering the

nuanced ways in which ADHD manifests and impacts daily functioning.

The Course and Changes in Presentation of ADHD Across the Lifespan

Attention-Deficit/Hyperactivity Disorder (ADHD) is defined as a persistent, trans-situational pattern of inattention and/or hyperactivity-impulsivity that is inconsistent with the individual's developmental level and interferes with social, academic, or occupational functioning. Crucially, ADHD symptoms should not be attributed to oppositional behaviour, defiance, hostility, or a lack of comprehension, although such behaviours may co-occur.

Longitudinal studies indicate that approximately **15% of children with ADHD** continue to meet full diagnostic criteria by age 25, and an additional **50% experience partial remission**, maintaining subthreshold symptoms that still impair functioning. However, these figures vary depending on the population studied and the methods used. More recent research, particularly among individuals diagnosed with the **DSM-IV Combined Type**, suggests higher persistence rates—likely due to the severity of cases and the use of informant-based assessments rather than self-reports.

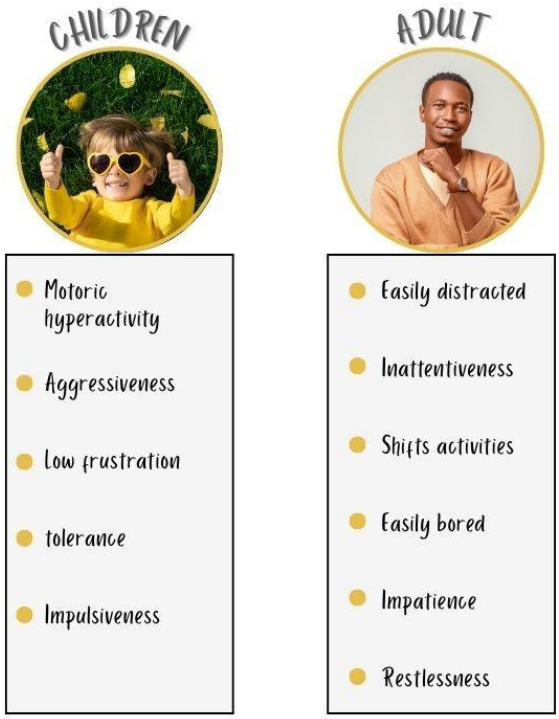
The **prevalence of ADHD in children** is estimated at around **5–7% globally**, while rates in adults range from **2.5% to 3.4%**, reflecting methodological differences in diagnostic approaches, criteria application, and symptom measurement. Because ADHD symptoms are continuously distributed across the general population, diagnosis relies on identifying individuals with **clinically significant impairment**, rather than discrete symptom clusters.

1) **Developmental Shifts in Symptom Profile**

   ADHD symptoms evolve across the developmental trajectory:

   - **Early Childhood**: Symptoms of hyperactivity and impulsivity dominate, often presenting as overt externalizing behaviours.
   - **Middle Childhood**: Inattention becomes increasingly prominent, contributing to academic challenges.
   - **Adolescence and Adulthood**: Hyperactivity often subsides in observable behaviour, while inattention tends to persist. Emotional dysregulation may become more pronounced and, in some cases, a dominant clinical feature.

   This evolving symptom profile contributed to the shift in DSM-5 from defining ADHD by static subtypes (as in DSM-IV) to describing **clinical presentations** that can change over time.



2) Sex Differences Across Development

Sex-based differences in ADHD diagnosis are well-documented and vary by developmental stage:

- In **child and adolescent clinical settings**, males comprise approximately **80% of ADHD cases**, likely due to higher rates of hyperactive-impulsive and disruptive behaviours.
- In **adult clinics**, the gender ratio approaches parity (~50% male), suggesting that many girls with inattentive symptoms remain underdiagnosed during childhood.

Girls are more likely to exhibit internalizing and less disruptive forms of ADHD, which may lead to underrecognition. In adulthood, while inattention remains more common in women, the level of hyperactivity-impulsivity tends to decline in men, reducing the observed sex differences.

Comorbidities also affect referral patterns. Boys more frequently present with externalizing behaviours and learning difficulties, whereas **adult women are more likely to seek help** for internalizing symptoms. Despite these differences, comorbidity rates for anxiety, depression, and other conditions appear similar between men and women with ADHD.

3) Adult ADHD: Expanded Symptomatology

While DSM-5 criteria were developed primarily for children, they have been validated for adult populations. However, many adults with ADHD report symptoms that extend beyond core diagnostic features, including:

- **Age-adjusted core symptoms**: Internal restlessness, difficulty maintaining focus in conversations, and persistent mental distraction.
- **Self-regulation difficulties**: Impulse control issues, emotional dysregulation, poor task initiation, and difficulty with organization and problem-solving.
- **Associated challenges**: Sleep disturban-

ces, chronic low self-esteem, and increased susceptibility to anxiety and depression.

These domains—particularly self-regulation difficulties—are correlated with core ADHD symptoms but do not consistently align with neuropsychological tests of executive function, suggesting that dysfunction arises from multiple, interacting neural networks.

METHODS FOR THE DIAGNOSIS OF ADHD

Like all other neuropsychiatric disorders, ADHD is diagnosed on a clinical basis. No biomarker has yet been found with adequate sensitivity and specificity. Nonetheless, ADHD can be reliably diagnosed if the diagnostic criteria are carefully scrutinized and differential diagnoses are excluded.

The diagnostic evaluation integrates information from a detailed developmental history and family history, a psychological diagnostic evaluation, and a physical diagnostic evaluation, including a differential diagnostic evaluation. If the patient is a child or adolescent, the current clinical symptoms and their severity in multiple areas of life are primarily assessed through information from the parents and/or other adults who interact with the child. Information from multiple observers who deal with the patient in different areas of life should always be considered.

In adulthood, the diagnostic evaluation is based mainly on talking with the patient, although information from family members or third parties (e.g., school report cards) can be helpful. Useful diagnostic aids include structured or semi-structured interviews and checklists to assist in clinical judgments, and disorder-specific questionnaires to determine how the patient is viewed by parents and teachers, as well as by him or herself. Such questionnaires are now available for the diagnosis of ADHD in children, adolescents, and adults according to either the ICD-10 or the DSM-5.

For diagnosis, the symptoms must have led to a marked impairment of the patient's performance and/or functioning in the social

environment. In ADHD/HKD, the degree of severity of the core symptoms is not simply a function of the affected person's age and developmental state. Questionnaires and checklists enable inexpensive, systematic, and standardized data collection from multiple areas of life, but may yield misleading findings. If discrepancies in the assessment of the patient remain, it may help to try to resolve these with the aid of more information, which can be obtained over the telephone (e.g., from teachers or carers) or in further face-to-face conversation (e.g., with the patient's grandparents). Persons filling out questionnaires are often reluctant to give answers that cast the child in a negative light, or they may have other personal reasons for giving a modified answer [14, Rank 3]

The diagnostic evaluation can also be supplemented with psychological tests, which are necessary when certain specific differential-diagnostic questions have to be answered. About half of all persons with ADHD have normal neurocognitive test findings despite marked core symptoms of the disorder

Laboratory tests and ancillary tests can be helpful for the investigation of possibly underlying somatic disease (e.g., thyroid disease, disturbances of sight and hearing, organic sleep disorders, drug-induced disorders) or in differential diagnosis (e.g., to distinguish ADHD from absence epilepsy).

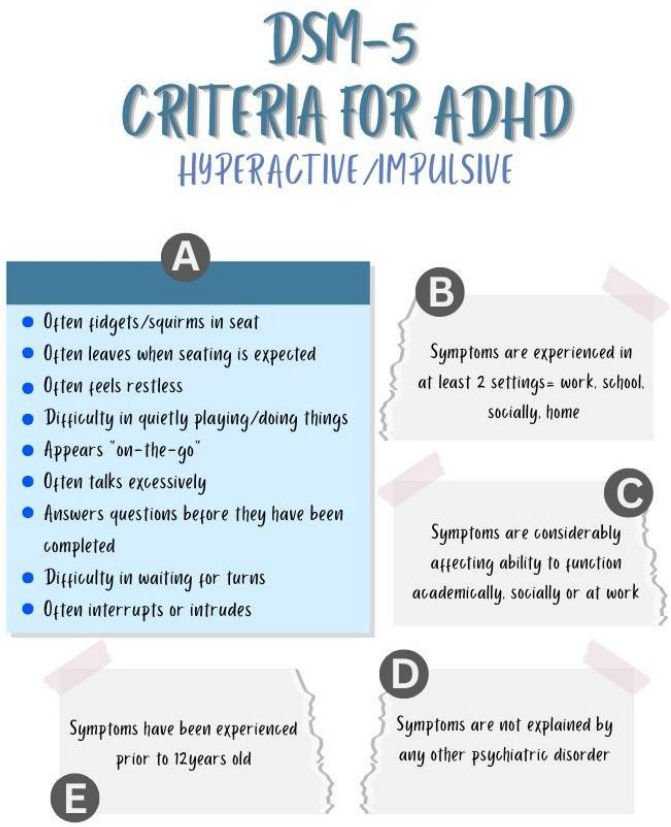
ADHD often needs to be distinguished from a conduct disorder or depression. Very careful distinctions must be drawn between the core symptoms of ADHD (impaired concentration, impulsivity, hyperactivity) and the dissocial and aggressive symptoms that characterize conduct disorder. Further observation over time can clarify whether an observed lack of ability to concentrate combined with heightened irritability is primarily or entirely due to a depressive mood disturbance, rather than being a chronic manifestation of ADHD. Other, less common and very rare differential diagnoses include attachment disorders and schizophrenic and bipolar prodromes. [15, Rank 3]

The clinician must make the diagnosis in the light of all the findings, and not merely based on questionnaires or behaviour observation in a test setting in the absence of a thorough developmental history. Differential diagnoses must be considered and ruled out. Nor can the diagnosis of ADHD be made or excluded solely based on psychological testing. The lack of essential information, e.g., prohibition of contact with the school, weakens the validity of the diagnosis.

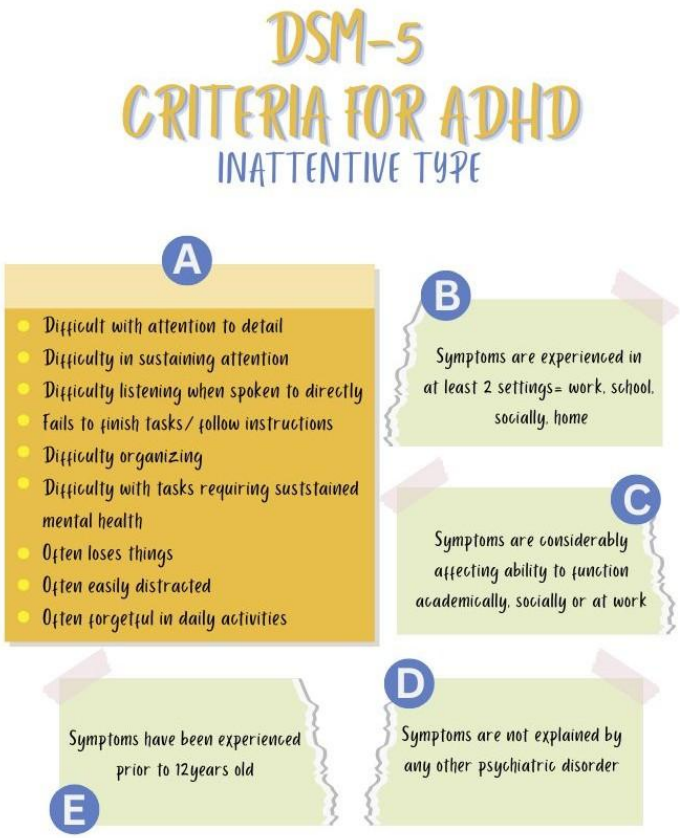
THE CLINICAL PROFILES OF ADHD

Attention-Deficit/Hyperactivity Disorder (ADHD) is most commonly diagnosed during school-age years, particularly between ages 6

and 12, when increasing academic and behavioural demands highlight functional impairments. According to the DSM-5, ADHD is a neurodevelopmental disorder marked by persistent inattention and/or hyperactivity-impulsivity, with several symptoms present before the age of 12 and manifesting in at least two settings (e.g., home, school, work).



However, the clinical course of childhood ADHD is notably heterogeneous. Developmental studies have shown that ADHD symptomatology evolves with age: motor restlessness tends to dominate in preschoolers, whereas disorganization, impulsivity, and inattention are more prominent in adolescents and adults. While hyperactive-impulsive symptoms generally decline over time, inattentive symptoms often persist into adulthood and may be lifelong. Gender differences are also evident—boys are more frequently diagnosed than girls, and females are more likely to exhibit the predominantly inattentive presentation.



Recently, increasing numbers of adolescents and adults have presented with symptoms resembling ADHD, despite a lack of documented childhood onset. Studies estimate that 2.5%–10.7% of individuals with ADHD symptoms first exhibit impairments in adolescence or adulthood. However, these cases are controversial, as the DSM-5 does not recognize adult-onset ADHD, and many late-onset cases may instead reflect alternative explanations such as substance use, mood

disorders, or other comorbid psychiatric conditions. In addition to the DSM-5's three presentations of ADHD, some researchers have proposed emotion dysregulation—particularly emotional lability and poor frustration tolerance—as a potential core dimension of ADHD. Although not formally recognized as a subtype, deficient emotional self-regulation has increasingly been viewed as a clinically significant component contributing to impairment and diagnostic complexity.

COMORBID MENTAL DISORDERS IN ADHD

Approximately 75% of persons with ADHD have an additional mental disorder and around 60% have multiple comorbid mental disorders; this can adversely affect prognosis and may necessitate specific therapeutic measures. Circumscribed developmental disorders (motor function, language, scholastic skills), anxiety disorders, tic disorders, and oppositional-defiant disorder emerge early in child development. In contrast, depressive disorders and severe conduct disorders often emerge later on, toward the end of the elementary school years and during the transition to adolescence.

From adolescence onward, such disorders are often associated with substance abuse and dependence and with the development of personality disorders. Approximately one in four children receiving treatment for ADHD also have an affective disorder, while over half of all adults with ADHD have clinical depression. Thus, the age-dependent development of comorbid disorders often occurs in specific sequential steps (e.g., from oppositional disorders, through conduct disorder, to depression with increased suicidality), particularly as comorbid disorders constitute specific risk factors for the development of further mental disorders.

Domination of Comorbid Conditions in ADHD

To complicate matters further, not only does the clinical phenotype of ADHD change over the lifespan, but comorbid conditions might dominate the initial appearance of a patient. This is of high relevance as ADHD patients frequently suffer from psychiatric and non-psychiatric comorbid conditions, posing significant clinical and public health problems. Throughout the lifespan, the specific pattern of comorbidities changes substantially: in short, while in children oppositional defiant disorder (ODD) and conduct disorder (CD) are the most prevalent comorbid conditions, substance use disorders (SUDs) become more and more of a problem during adolescence and even more so in adulthood. The comorbidity pattern of adult ADHD is highly diverse, and in addition to SUDs encompasses mood and

anxiety disorders, antisocial personality disorder (ASP), sleep disorders, as well as many somatic diseases. The developmental trajectory, risk factors, and moderators of this lifelong comorbidity course, however, are currently only poorly understood and require future studies

Autism spectrum disorders, tics, and learning disorders

ADHD and symptoms of autistic spectrum disorders (ASDs) often co-exist, as 20–50% of children with ADHD also meet criteria for ASDs. Several studies have shown social deficits, peer relationships, and empathy problems to be common in ADHD, and accordingly, the DSM-5 finally allows a comorbid diagnosis of ADHD and ASD. The ADHD-ASD comorbidity has mainly been studied in children; a review and meta-analysis, however, support its existence also in adults.

Recent data from a large, register-based study suggest that the comorbidity has its roots in shared genetic/familial factors. Tic disorders occur in up to 3–4% of the population and are seen in 10 to 20% of children with ADHD. Over the years, tic severity typically peaks between 8 and 12 years of age. The natural history of tics usually shows a marked decline during adolescence. Population studies suggest that intellectual disability may be more common (up to 5–10 times) in ADHD than in children without ADHD. About 25–40% of all patients with ADHD have major reading and writing difficulties, and many show co-existing language disorders. Similarly, there is a considerable overlap between ADHD and disorders of arithmetical skills. [27, Rank 4]

Rule-breaking behaviours

The comorbidity of ADHD with antisocial behaviours is of particular societal relevance, as ADHD seems to convey an increased risk for violence and incarceration, especially in the context of such comorbidity. In children and adolescents, both clinical and epidemiological studies show a high prevalence of comorbidity of ADHD with ODD/CD. ODD and CD predict a more severe clinical symptomatology, more severe functional impairments, higher persistence of ADHD into adulthood, and worse outcome of the disorder. They also mediate the risk for the development of other problems, such as substance use and depression. Comorbid ODD in childhood seems to also increase the risk for CD/ASP and depression in ADHD later in life, and comorbid CD does even more. Increased impulsivity may be an important risk factor within the ADHD group for these negative outcomes. However, ADHD-affected children without these comorbidities may also develop antisocial behaviours later in life. SUDs and environmental variables might be important

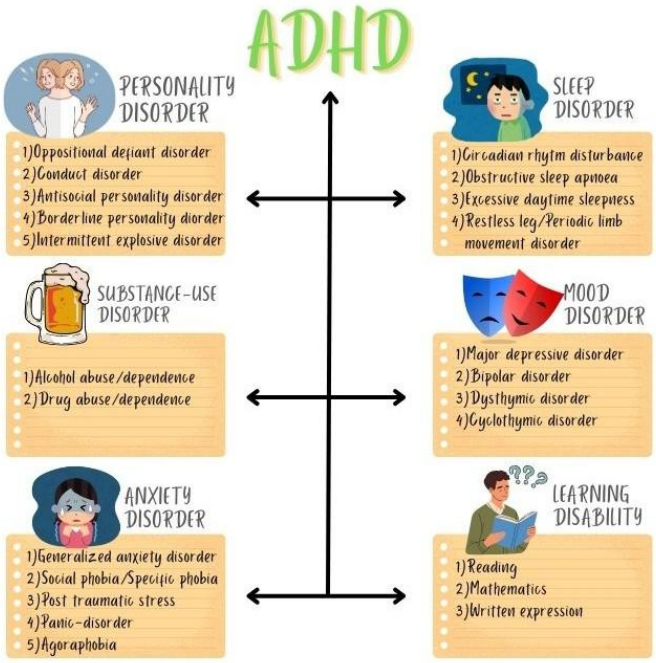
moderators in this, although this has yet to be formally established. [28, Rank 3]

Substance use disorders

Another related issue of importance in ADHD across the lifespan is the liability to develop addictions. The earlier onset and increased use of tobacco, alcohol, and illicit substances in adolescents with ADHD compared to controls has been demonstrated in various studies, and a high prevalence of drug abuse or dependency is also reported in adulthood. A meta-analysis confirmed that childhood ADHD significantly increases the risk for nicotine use in middle adolescence and the risk for alcohol use disorder during young adulthood. This meta-analysis also suggested that children with ADHD may have an elevated risk for cannabis use and psychoactive substance use as young adults, but significant heterogeneity exists between studies, and the association with drug use disorder was highly influenced by a single study.

As another meta-analysis showed, controlling for comorbid disorders (particularly CD) substantially weakened the association between ADHD and SUDs; in fact, it could not be confirmed that ADHD increases the risk for SUDs beyond the effects of CD/ODD. Looked at from the other side, in adult patients suffering from alcohol abuse, 30–70% suffered from childhood ADHD, and 15–25% still displayed the disorder as adults.

Mood and anxiety disorders



Adult ADHD is significantly comorbid with anxiety disorders and major Although these disorders are among the most common comorbidities of ADHD, especially in adolescents and adults, surprisingly little is known about the developmental trajectories of such comorbidity. As mentioned above, ODD/CD seem to be associated with later-life affective disorders; also, depressive and anxious symptoms during childhood and adolescence go along with increased risk for adult-life depression (as do general risk factors for depression), although often no such antecedents can be found in adult ADHD with depression. Rather, childhood ADHD itself seems to be a risk factor for the later development of depression, which can be redu-

ced by e.g. methylphenidate treatment.

Disruptive mood dysregulation disorder and bipolar disorder

An issue of increasing interest in research and clinical is the presence of extreme and uncontrolled emotional and mood changes in both children and adults with ADHD. Indeed, in DSM-5, problems with emotion regulation are listed as characteristic features of ADHD that support the diagnosis. Emotional dysregulation and ADHD are known to share genetic risks. In adult ADHD, emotional dysregulation also occurs in the absence of comorbid disorders, is an independent predictor of impairment, and responds to both stimulants and atomoxetine.

In some cases, specialist referral is advised to ensure accurate diagnosis, because the problems may be complex and predictive of particular adverse outcomes. Comorbidity with bipolar disorder and borderline personality disorder both need to be considered in adults, since ADHD may co-exist with these conditions, but may also mimic them in the presence of severe emotional dysregulation.

Cross-sectional epidemiological studies as well as family-based studies show that there is increased comorbidity between bipolar disorder and current or lifetime ADHD; mutual comorbidity rates are around 20%. The developmental trajectories of this comorbidity are unclear, however, since bipolar disorder is rare in pre-adolescents, even when severe irritability and anger are prominent in this group. The new DSM-5 diagnosis "disruptive mood dysregulation disorder (DMDD)" for children up to age 8 years exhibiting persistent irritability, intolerance to frustration, and frequent episodes of extreme behavioural dyscontrol captures those symptoms, yet the course of this syndrome into full-blown bipolar disorder is far from established. Importantly, most of the DMDD patients also meet criteria for ADHD. [29, Rank 3]

ASSOCIATED IMPAIRMENTS AND COMORBIDITIES IN ADHD: CLINICAL AND DEVELOPMENTAL CONSIDERATIONS

Comorbidities Associated with ADHD

ADHD appears to be associated with a wide variety of other psychiatric problems, which are often co-morbid with it. ADHD co-occurs with other childhood disorders far more often than it appears alone. Notable associations exist with Oppositional Defiant Disorder (ODD), Conduct Disorder (CD), tic disorder, mood disorder, autism spectrum disorder, specific learning disorder, such as dyslexia, depression, and anxiety. About 50-60% of children with ADHD meet criteria for ODD, even in the pre-

school period.

One study reported that ADHD children in primary care settings were significantly more likely than non-ADHD clinic controls to demonstrate mood disorders such as depression, multiple anxiety disorders, and substance use disorders. However, a recent study has found that anxiety was not associated with ADHD when adjustment was made for the presence of a third disorder. It is widely accepted that ADHD is a co-morbid disorder.

One study found that co-morbidity can mean a common underlying aetiology which leads to two or more different disorders, or that one disorder leads to another, or even that two unrelated disorders co-occur. The term co-morbid also implies that their entities are morbid conditions, *i.e.* diseases. High rates of comorbidity with either other neurodevelopmental disorders (*e.g.*, mental retardation, and learning disabilities) or psychiatric disorders (*e.g.*, anxiety) make delineation of the phenotype difficult.

Some studies found that 47% children with ADHD have co-morbid ODD, 27% have anxiety disorder and 7% have mood disorder. 38% of children with ADHD were found to have CD and 13% have depression. In fact, the vast majority of co-morbidities with ADHD represent functional impairments and symptoms, which are not rooted in specific diseases. Studies of clinic-referred children with ADHD find that between 54% and 67% will meet criteria for a diagnosis of ODD by 7 years of age or later. ODD is a frequent precursor to CD, a more severe and often (though not always) later occurring stage of ODD.

In addition to associations with other psychiatric disorders children with ADHD are also more likely than their non-ADHD counterparts to experience a substantial array of developmental, social and health risks. It therefore seems important to discuss associated problems along with co-morbidity. [20, Rank 4]

Motor coordination

Children with ADHD often demonstrate poor motor co-ordination or motor performance and balance. Substantial evidences have been observed for problems in motor development and motor execution children with ADHD. Clinical and epidemiological studies report that 30% to 50% of children with ADHD suffer from motor coordination problems. These percentage are dependent of the type of motor assessment, referral sources and the cut-off points used. Children with ADHD display greater difficulties with the development of motor coordination, planning and execution of complex, lengthy tasks, and novel chains of goal directed responses.

Academic functioning

Children with ADHD have an impaired acade-

mic functioning and are usually at an educational disadvantage upon school entry. ADHD children are more likely than their non-ADHD peers to demonstrate difficulties with basic mathematics and pre-reading skills during their first year at school. Executive academic functions were found to be core deficits specific to ADHD. Girls with ADHD were found to be less impaired than boys with ADHD. Even pre-school children with ADHD demonstrate educational disadvantage.

Studies found that pre-school ADHD children demonstrate deficits in pre-academic skills even prior to formal school entry. The pre-school ADHD children score on average one standard deviation lower, than did their non-ADHD control group. Researchers emphasized the importance of look away behaviour (inattention) as a major reason for poor academic achievement [21, Rank 5]

Clinic-referred children with ADHD often present with lower scores on intelligence tests than control groups, specifically verbal intelligence with differences ranging from 7 to 10 standard score points. Studies with community samples of ADHD children have also demonstrated negative associations between ADHD and intelligence.

Children with ADHD demonstrate serious difficulties with psychosocial functioning. Social adjustment is often given little attention, given its designation as an associated feature of ADHD. However, the high levels of disruptive behaviour demonstrated by ADHD children increases the likelihood of negative reactions from parent, teachers and also peers. In addition, negative social interactions with peers ultimately lead to peer's rejection, because these social difficulties are often resistant to psychosocial and pharmacological treatment, they are expected to continue into adolescence, and even adulthood when criteria for the disorder may no longer be met.

The patterns of disruptive, intrusive, excessive, negative, and emotional social interactions that have been found between children with ADHD and their parents, have also been found to occur in the children's interactions with teachers and peers. It should come as no surprise, then, that those with ADHD receive more correction, punishment, censure, and criticism than other children from their teachers, as well as more school suspensions and expulsions, particularly if they have ODD/CD. In their social relationships, children with ADHD are less liked by other children, have fewer friends, and are overwhelmingly rejected as a consequence, particularly if they have comorbid conduct problems. Another research study demonstrated that the co-occurrence of conduct disorder and anxiety disorder with ADHD in childhood predicted a more severe course for ADHD in adolescence [22, Rank 4]

Unintentional physical injury

Children with ADHD appear to be at a greater risk for unintentional physical injury and accidental poisoning. In one of the studies of the issue, it was found that four times as many hyperactive children as control children were described by parents as accident-prone. Later studies have also identified such risks; up to 57% of children with hyperactivity or ADHD are said to be accident-prone by parents, relative to 11% or fewer of control children. Most studies find that children with ADHD experience more injuries of various sorts than control children. In one study, 16% of the hyperactive sample had at least four or more serious accidental injuries (broken bones, lacerations, head injuries, severe bruises, lost teeth, etc.), compared to just 5% of control children.

Several other studies likewise found a greater frequency of accidental injuries than among control children. Researchers found that children with ADHD were at a greater risk for suffering fractures, most likely as a result of hyperactive and impulsive behaviour. Children with AD/HD are also more likely than their non-ADHD counterparts to be injured as pedestrians, to inflict injuries to themselves, to sustain injuries to multiple body regions and to experience head injury. Knowledge about safety does not appear to be lower in these children, implying interventions aimed at increasing knowledge about safety may have little impact. [23, Rank 3]

Sleep disturbances

Studies report an association between ADHD and sleep disturbances, found that sleep problems occurred twice as often in ADHD. The problems are mainly more behavioural and include settling difficulties, a longer time to fall asleep, and instability of sleep duration, tiredness at awakening or frequent night waking. Sleep difficulties may increase ADHD symptoms during the daytime, as the research on normal children implies. Yet some research finds that the sleep problems of children with ADHD are not associated with the severity of their symptoms; this suggests that the disorder, not the impaired sleeping, is what contributes to impaired daytime alertness, inattention, and behavioural problems.

While knowledge about the associations between ADHD and other related variables is useful in terms of diagnostic profiles, less is known about the impact of related variables on the long-term outcome for the disorder. Even less is known about the specificity of these associated problems to ADHD.

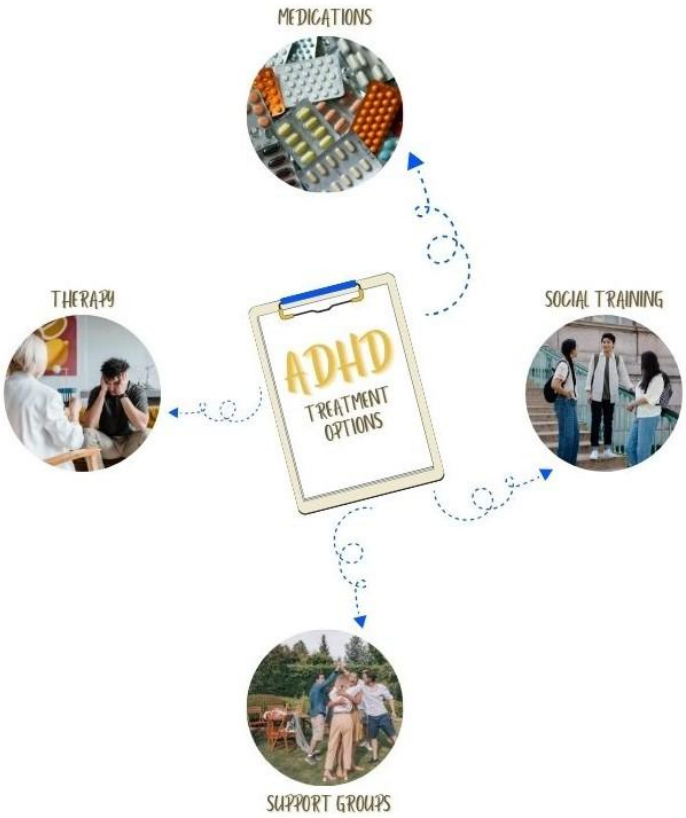
Children with a pre-school variant of ADHD present with the same symptom structure, similar associated impairment and developmental risk, and similar patterns of neuropsychology. Despite the similarities

between pre-school ADHD and school-aged ADHD, little is known about what constitutes impairment during the pre-school years although school readiness should be what clinicians focus on. And even less is known about the relationship between early hyperactivity and later expression of the ADHD disorder.

While originally conceived of as a disorder of childhood and adolescence, evidence suggests scientific merit and clinical value in examining ADHD in adulthood, as well as the pre-school period. ADHD symptoms have been shown to persist into later life with up to 40% of childhood cases continuing to meet full criteria in the adult years. Adult ADHD appears to share many characteristics of the childhood disorder. Similar to their childhood counterparts, adults with ADHD display impairment in the interpersonal, vocational, and cognitive domains. The adult and childhood disorders also appear to share a common neuropathology and demonstrate a similar response to treatment. [24, Rank 5]

TREATMENT STRATEGIES FOR ADHD

Treatment strategies for Attention-Deficit/Hyperactivity Disorder (ADHD) encompass pharmacological, behavioural, and combined approaches. Stimulant medications, which enhance dopaminergic and noradrenergic neurotransmission, particularly in the prefrontal cortex, are considered the first-line pharmacologic treatment. Commonly prescribed stimulants include methylphenidate (e.g., Ritalin, Concerta, Metadate, Methylin) and amphetamine-based formulations (e.g., dextroamphetamine [Dexedrine, Dextrostat] and mixed amphetamine salts [Adderall]). In addition to medication, evidence-based behavioural interventions play a critical role, especially in paediatric populations. These include parent training in behaviour management, cognitive-behavioural therapy (CBT), classroom-based behaviour interventions, and social skills training. Combined pharmacological and behavioural therapies are often more effective than either modality alone.



Despite the availability of effective treatments, no curative intervention exists for ADHD, owing to the complex and heterogeneous nature of its neurodevelopmental underpinnings. Psychiatric comorbidities such as anxiety disorders, depression, bipolar disorder, substance use disorders, and certain personality disorders frequently co-occur with ADHD. These comorbid conditions complicate the diagnostic process and influence treatment planning and outcomes. Moreover, treatment response varies significantly among individuals, with differences observed in medication efficacy, dosage requirements, tolerability, and adverse effect profiles. This heterogeneity is attributed to multiple factors, including neurobiological variability and genetic differences. For instance, the therapeutic response to methylphenidate has been associated with individual differences in dopamine release, as well as polymorphisms in genes encoding the dopamine transporter (DAT1), dopamine receptor D4 (DRD4), norepinephrine transporter (NET), and the serotonin transporter (5-HTTLPR). Understanding these individual differences holds promise for more personalized and effective ADHD management in the future.

Treatment for ADHD

ADHD is generally treated in the outpatient setting. If outpatient treatment fails due to poor compliance, inadequate family resources, difficult drug adjustments, or impending expulsion from school, it may be necessary to conduct partial or full inpatient treatment. Certain differential diagnostic questions or a complex burden of comorbidities constitute further possible reasons for inpatient treatment.

Most widely researched and commonly prescribed treatments for ADHD are the psychostimulants, including methylphenidate, amphetamine, and pemoline. Several studies have demonstrated the short-term efficacy of stimulants compared to conditions in improving both core ADHD symptoms and important ancillary features of the disorder. Several studies of stimulants have shown their effect on reducing interrupting in class, reducing task-irrelevant activity in school, improving performance on spelling and arithmetic tasks, improving sustained attention during play, and improving parent-child interaction.

Meaningful effects have been documented across a wide array of outcome domains, including cognitive attentional performance, school behaviour, and learning, parent-child interactions, interaction with peers, and with a wide variety of assessment approaches, direct observations of behaviour in natural and laboratory settings, and objective laboratory performance. [18, Rank 3]

Treatment guidelines from U.S. and abroad now recommend a combination of multiple, individually adapted treatment components (multimodal treatment). The foundation of all therapeutic interventions is psychoeducation to impart information about the disorder and potential treatment approaches to the parents, as well as to the child or adolescent patient in an age-appropriate manner.

Cognitive behavioural therapy techniques are also used in both individual and group settings:

- **In childhood and adolescence**:

  parent training, interventions in kindergarten and in school, e.g., a therapy program for children with problematic hyperkinetic and oppositional behaviour.

- **In adulthood:**

  specific psychotherapy manuals. [16, Rank 2]

Meta-analyses have shown that food supplementation with unsaturated fatty acids has a weakly statistically significant but clinically irrelevant effect on the core symptoms of ADHD. Nor are any other dietetic measures generally of therapeutic use. The utility of neurofeedback as part of a multimodal overall treatment plan remains unclear. So far, an insufficient number of studies with high-quality training protocols have been performed. Such studies would probably yield better results than other approaches

Alongside these treatments, pharmacotherapy is a further essential component of ADHD treatment. The efficacy and tolerability of treatment with stimulants have been demonstrated repeatedly in many meta-analyses, e.g., that of the National Institute of Excellence.

Randomized trials on the long-term efficacy of treating ADHD with stimulants cannot be performed for ethical reasons. The last three decades have seen a marked rise in the number of studies on the long-term results of treatment. Longitudinal studies of brain development have revealed a structural normalization of brain development under treatment with stimulants.

The findings of several studies that have been adjusted for potential confounding factors suggest that drug treatment for ADHD reduces the risk of delinquent behaviour, substance abuse, suicidal behaviour, and accidents to a statistically significant and clinically relevant extent. Further studies have also shown a reduction of functional impairment and an improvement in health-related quality of life. In general, (drug) treatment leads to a more favourable temporal course of the core symptoms, associated psychiatric disorders, and relevant functional impairments, even though a fully normal state still cannot be achieved in most cases.

The decision for drug treatment should be-

made only after careful consideration in all cases, as should the further decisions about when to treat, for what duration, and at what dosage. Behavioural therapy is always preferable to drug therapy for preschool children and for school-age children with only mild symptoms. Primary treatment with drugs is indicated from school age onward in the case of pronounced and situationally independent ADHD symptoms that are causing marked functional impairment.

Moreover, there is evidence to support primary drug treatment for some children with moderate ADHD symptoms. For adults with ADHD, drugs are the first line of treatment. Patients must be followed up regularly over the long term to check for possible side effects of drug treatment; in particular, their blood pressure, heart rate, height, and weight should be regularly monitored. The effect of treatment should also be monitored with regular brief periods of discontinuation of the drug, generally once per year.

For the treatment of associated mental disorders, further psychotherapeutic interventions based on behavioural therapy, family systems therapy, or depth psychology may be helpful. Drugs may also be useful to treat certain comorbid psychiatric problems such as depression, tic disorders, and obsessive-compulsive disorder. [17, Rank 4]

Side Effects of Pharmacological Treatments for ADHD

In terms of drug treatment side effects, the most typical are decreased appetite, sleep disturbance, headaches, drowsiness, tearfulness, abdominal discomfort, nausea and vomiting, irritability, mood changes, constipation, fatigue, sedation, and increased blood pressure and pulse. Delays in height and weight are relatively minor with stimulants, often appear to attenuate with time, and seem not to affect ultimate height and weight in adulthood. The cardiovascular safety of stimulant medications and atomoxetine has been a subject of debate over many years. It is quite surprising that this controversy occurs for drugs such as methylphenidate, which have been on the market for over 50 years. Cohort studies, however, did not find an increase in serious cardiovascular events following ADHD medications in children or adults, although both stimulants and atomoxetine were found to be associated with slight increases in heart rate and blood pressure.

Public concerns that stimulant treatment in childhood and adolescence may increase SUDs in adulthood seem unsubstantiated. Several studies found that ADHD medication was not associated with an increased rate of substance abuse; if anything, the data suggest a long-term protective effect on substance abuse. [16, Rank 4]

Non-Pharmacological Approaches in ADHD Management

In addition to pharmacotherapy, several non-pharmacological approaches are used in the control and management of ADHD across the lifespan. In many countries, for children and adolescents with mild ADHD, non-pharmacological interventions are the first-line treatment. In moderate or severe cases, the recommendation is to combine non-pharmacological treatment and drug treatment. Thus far, non-pharmacological treatments in childhood have demonstrated lesser efficacy in reducing ADHD core symptoms than ADHD drugs, but may have important benefits for co-occurring comorbidities and behavioural problems.

Only free fatty acid supplementation and exclusion of artificial food colour from the diet demonstrated significant beneficial effects on ADHD core symptoms during childhood in a rigorous meta-analysis, although the effects were relatively small.

Of particular importance is the transition from childhood to adult services, requiring continuation of both medical and psychological support. As indicated above, for adults, pharmacological treatment is the recommended first choice. Group CBT has been proven to benefit adults with ADHD, but one study showed that highly structured group intervention did not outperform individual clinical management with unstructured support about the core ADHD symptoms. Promising findings also raise the possibility of mindfulness-based interventions as an effective treatment for ADHD symptoms [9, Rank 3]

The Role of Diet in ADHD Management

Diet is another environmental influence, often cited by parents as having an adverse influence on the ADHD symptoms of their child. Specifically, food additives, refined sugars, and fatty acid deficiencies have all been associated with ADHD symptoms.

Several studies demonstrated a general adverse effect of food colouring and benzoate preservatives on hyperactive behaviour of preschool children, based on parental reports, but not on simple clinical assessment. Children with high levels of hyperactivity were no more vulnerable to this effect than children with low levels of hyperactivity. While improving children's diet might impact on their general health and improve their overall behaviour, the clinical importance of dietary change as a means of remediating ADHD remains doubtful. [19, Rank 4]

DISEASE OUTCOME IN ADHD

Assessment of disease outcome in ADHD requires longitudinal study designs, which are generally scarce. As a result, the knowledge about the role of treatment during the different

phases of life in such outcomes is still patchy. Some clinically-based studies of high quality that have followed up pre-adolescents with ADHD into adulthood are already available and have been instrumental in documenting the disease outcomes of ADHD in different aspects of life. Those include academic, occupational, and social aspects as well as morbidity and mortality. It has been shown that ADHD is associated with academic outcomes, such as poor academic performance (e.g., lower grade point average and increased rates of grade retention) and lower rates of high-school graduation and post-secondary education.

ADHD is also associated with negative occupational outcomes such as unemployment, having trouble keeping a job, financial problems, and work incapacity in terms of sickness absence. Studies have also shown that individuals with ADHD are at increased risk for poor social outcomes such as high rates of separation and divorce, residential moves, and early parenthood.

In terms of mortality, several studies from Scandinavia have explored the association of ADHD with mortality and which factors are likely to increase mortality. These studies have used information from national registers that have been linked using a unique person identifier. One study has found that ADHD is associated with significantly increased mortality rates, and that the excess mortality in ADHD is mainly driven by deaths from unnatural causes, especially accidents.

Others have confirmed that individuals with ADHD are at increased risk for serious transport accidents, and also show increases in criminality and suicidal behaviour, which are severe negative outcomes in their own right and could contribute to the increased mortality.

Systematic reviews of the long-term disease outcomes of treated versus untreated ADHD are somewhat inconsistent. This is partly because long-term observational studies are often limited by a lack of data about treatment compliance and can be confounded by indication, since more severe cases will be more likely to be treated. A systematic review of randomised controlled trial open-label extension studies and naturalistic studies of adults with ADHD concluded that ADHD medications have long-term beneficial effects and are well tolerated, but that more longitudinal studies of long duration need to be performed

Another second systematic review of both childhood and adult studies found that ADHD individuals left untreated had poorer long-term outcomes compared to treated individuals in several major categories including academic, antisocial behaviour, driving, non-medicinal drug use/addictive behaviour, obesity, occupation, services use, self-esteem, and social function outcomes, but that treatment did not

result in normalisation. In contrast, some other studies concluded that ADHD medication reduced ADHD symptoms and impairments, but that there was limited and inconsistent evidence for long-term medication effects on improved social functioning, academic achievement, employment status, and psychiatric comorbidity. Long-term trials would be needed to allow definite conclusions, yet those are almost impossible to conduct in real life.

CONCLUSION

ADHD is a developmental disorder that has not become any more prevalent in the general population in recent decades but that has nonetheless become increasingly well recognized. As it leads to functional impairment in multiple areas of life, is often associated with the development of comorbid mental disorders, and can have lifelong adverse consequences for the patient, ADHD requires early, need- and age-adapted treatment consisting of psychoeducation, behavioural therapy, and treatment with psychoactive drugs. There are effective methods of treatment for both the core and accompanying symptoms of ADHD.

Attention-deficit/hyperactivity disorder (ADHD) is a common, early-onset, persistent developmental disorder of childhood and adolescence, with a prevalence of approximately 5%. At least 75% of affected children and adolescents develop a comorbid disorder, which impedes diagnosis and treatment and worsens prognosis. The aetiology of ADHD is complex and heterogeneous, involving a major genetic component and diverse neurobiological alterations. Prenatal environmental factors also seem to elevate the risk of ADHD. The mainstays of treatment are psychoeducation, behavioural therapy, and psychoactive drugs, which generally have only mild side effects, such as insomnia or decreased appetite. The indication for treatment in the individual case is based on severity, comorbidity, previous therapy attempts, and the familial, social, and educational framework conditions. [30, Rank 5]

REFERENCES

1. Ghanizadeh A. Psychometric analysis of the new ADHD DSM-V derived symptoms. BMC Psychiatry 2015

2. Jenson P. Current concept and controversies in the diagnosis and treatment of attention deficit hyperactivity disorder. Curr Psychiatry Rep 2016

3. Burke JD, Rowe R, Boylan K. Functional outcomes of child and adolescent oppositional defiant disorder symptoms in young adult men. J Child Psychol Psychiatry 2017

4. Barkley RA, Fisher M, Smallish L, Fletcher K. The persistence of attention

deficit/hyperactivity disorder into young adulthood as a function of reporting source and definition of disorder. J Abnorm Psychol 2017

5. Keenan K, Shaw DS, Walsh B. DSM-III-R disorders in preschool children from low-income families. J Am Acad Child Adolesc Psychiatry 2017

6. Lavigne JV, Gibbons RD, Chirstoffel KK. Prevalence rates and correlates of psychiatric disorders among preschool children. J Am Acad Child Adolesc Psychiatry Med 2016

7. McGough JJ, Barkley RA. Diagnostic controversies in adult attention deficit hyperactivity disorder. Am J Psychiatry 2018

8. Currie J, Kahn R. Children with disabilities: introducing the issue. Future Children 2018

9. Breggin P. Talking back to ritalin: what doctors aren't telling you about stimulants and ADHD. 2nd ed. Cambridge: De Capo Press; 2017

10. Stein D. Unraveling the ADD/ADHD fiasco: successful parenting without drugs. Kansas City: Andrews McMeel; 2015

11. National Institute of Clinical Excellence (NICE). Attention deficit hyperactivity disorder Diagnosis and Management of ADHD in children, young people and adults. London: NICE Clinical Guideline; 2019

12. Biederman J, Faraone SV, Mick E, et al. High risk for attention deficit hyperactivity disorder among children of parents with childhood onset of the disorder: a pilot study. Am J Psychiatry 2019

13. Faraone SV, Sergeant J, Gillberg C, Biederman J. The worldwide prevalence of ADHD: is it an american condition? World Psychiatry 2019

14. Epstein JN, Loren RE. Changes in the definition of ADHD in DSM-5: subtle but important. Neuropsychiatry 2019

15. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed. Washington, DC: American Psychiatric Pub.; 2017

16. American Psychiatric Association. Diagnostic and statistical manual of mental disorders, DSM-IV-TR. 4th ed. Washington, DC: American Psychiatric Pub.; 2018

17. Kessler RC, Üstün TB. The world mental health (WMH) survey initiative version of the world health organization (WHO) composite international diagnostic interview (CIDI). Int J Methods Psychiatr Res 2015

18. Goldman LS, Genel M, Bezman PJ, Slanetz PJ. Diagnosis and treatment of treatment of attention deficit/hyperactivity disorder in children and adolescents: council on scientific affairs. JAMA 2018

19. McBurnett K. Attention deficit/hyperactivity disorder. Frances A, Widiger T, Pincus H, et al., eds. DSM-IV source book. Vol. 3, Washington, DC: American Psychiatric Press; 2017

20. Depue BE, Burgess GC, Willcutt EG, et al. Inhibitory control of memory retrieval and motor processing associated with the right lateral prefrontal cortex: evidence from deficits in individuals with ADHD. Neuropsychologia 2018

21. Sheppard B, Chavira D, Azzam A, et al. ADHD prevalence and association with hoarding behaviors in childhood onset OCD. Depression Anxiety 2017

22. Zametkin AJ, Ernst M. Current concept problems in the management of attention deficit hyperactivity disorder. N Engl J Med 2019

23. Elia J, Ambrosini PJ, Rapoport JL. Treatment of attention deficit disorder. N Engl J Med 2019

24. Szatmari P. The epidemiology of attention-deficit hyperactivity disorders. Child Adolesc Psychiatr Clin N Am 2016

25. Breton J, Bergeron L, Valla JP, et al. Quebec children mental health survey: prevalence of DSM-III-R mental health disorders. J Child Psychol Psychiatry 2017

26. Briggs-Gowan MJ, Horwitz SM., Schwab-Stone ME, et al. Mental health in pediatric settings: distribution of disorders and factors related to service use. J Am Acad Child Adolesc Psychiatry 2019

27. DuPaul GJ. Parent and teacher ratings of ADHD symptoms: psychometric properties in a community based sample. J Clin Child Psychol 2018

28. Pelham WE, Gnagy EM, Greenslade KE, Milich R. Teacher ratings of DSM-III-R symptoms for the disruptive behavior disorders. J Am Acad Child Adolesc Psychiatry 2018

29. Nolan EE, Gadow KD, Sprafkin J. Teacher reports of DSM-IV ADHD, ODD, and CD symptoms in schoolchildren. J Am Acad Child Adolesc Psychiatry 2017

30. Trites RL, Dugas F, Lynch G, Ferguson B. Incidence of hyperactivity. J Pediatr Psychol 2019