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Attention-Deficit/ Hyperactivity Disorder and Sports: A Lifespan Perspective



Lisa MacLean, MD^a, Deepak Prabhakar, MD, MPH^{b,*}

KEYWORDS

• ADHD • Athletes • Life span • Sport Psychiatry

KEY POINTS

- There is no standardized objective measure to make the diagnosis of attention-deficit/hyperactivity disorder (ADHD); the diagnosis is made with a thorough clinical history.
- Patients suffering from ADHD have twice the lifetime risk of substance use disorders compared with their non-ADHD peers.
- For athletes, the type of sport, level of play, and baseline health should be considered in the decision to use medications for the treatment of ADHD.
- The use of stimulants, although beneficial in athletes, is not without risk and potential for cardiovascular and thermoregulatory adverse events.
- In professional athletes who need treatment of ADHD, nonstimulants should be carefully considered; when stimulants are used, long-acting stimulants are preferred.

INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is a chronic and pervasive heritable neurobiological developmental disorder that can affect an individual throughout their life span. For diagnosis, the core symptoms of ADHD are hyperactivity, impulsivity, and/or inattention that emerge by age 12 years, cannot be due to another mental or medical condition, and cause impairment in at least 2 settings. ADHD affects about 5% of the general population younger than 19 years and about 4% of adults.¹ Because of its prevalence and negative impact on multiple domains over the course of a person's life, ADHD is considered a major health problem. The chapter provides an overview of ADHD from preschool to the adult years with a focus on its impact on athletes. It will also provide context to the progressive and changing needs of the patient with treatment recommendations for an athlete throughout every stage of their athletic career.

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ATTENTION-DEFICIT/HYPERACTIVITY DISORDER ACROSS THE LIFE SPAN

ADHD occurs in approximately 2% to 5% of children in the preschool age group.² The impairments seen at this age are similar to those seen in older school age children.³ ADHD in these age groups is characterized by inattentive, hyperactive, and impulsive behaviors. Struggling with social relationships and learning are common impairments seen in these children; they commonly interrupt conversations, have poor coordination, and blurt out inappropriate comments. They are also more likely to be suspended, be in accidents, and sustain injuries.⁴ Preschoolers and older school age children also demonstrate similar levels of psychiatric comorbidities, with the most common being learning and language disabilities, oppositional defiant disorder, conduct disorder, depression, and anxiety disorders.⁵ These behaviors can result in poor peer relationships, which can lead to further isolation and low self-esteem affecting the child academically and within the family unit. Research suggests that the younger the age of onset of symptoms, the more likely the disorder will be severe during childhood.⁶ Children who receive treatment have a better prognosis than those who do not.⁷

Approximately 50% of children will continue to meet diagnostic criteria for ADHD into adolescence. However, with development, hyperactivity, although still present, lessens in severity. Developmentally, adolescence is a time when decisions about life choices are made that could both positively and negatively affect an individual's future. In high school, adolescents must learn to function in an environment that is often more demanding and less structured. The influence of peers becomes particularly important and issues around poor self-regulation can create difficulty. In addition, several comorbid problems may arise that require treatment, such as antisocial personality characteristics, depression, anxiety, and substance abuse problems.⁸ In an empirically based literature review, Gillberg and colleagues found that beginning in their adolescent years, patients suffering from ADHD have twice the lifetime risk of substance abuse compared with their non-ADHD peers.⁹ The adolescent years are a time of transition when a young person learns of their personal responsibility for their actions. By age 21 years, 95% of teenagers stop taking medication, and this decline is unlikely due to resolution of symptoms,¹⁰ and this puts adolescent patients with ADHD at greater risk for negative outcomes and could slow the successful transition from adolescence to adulthood.

The estimated point prevalence of ADHD is about 4% in the adult general population.¹¹ Thus, a substantial proportion of young adults continue to have symptoms or associated problems that may require treatment. Indeed, current estimates suggest that about half of the patients with childhood ADHD continue with symptoms into adulthood.¹¹ Similar to adolescence, impulsivity and hyperactivity tend to abate, but attentional problems persist into adulthood.¹² Adults often experience more difficulty with procrastination, time management, and organization, which can be particularly problematic for college students. Furthermore, most adults with ADHD can experience multiple negative life events related to academic underachievement, problematic driving, underemployment or recurrent unemployment, imprisonment, and problems with forming and maintaining relationships.¹³ Comorbid problems include mood and anxiety disorders, emotional dysregulation, low frustration tolerance, irritability, anger, insomnia, increased risk taking, and problems with alcohol and substance misuse. Impulsivity may place patients at greater risk to injure themselves, resulting in higher rates of traumatic brain injury and other injuries (**Table 1**).

ADHD symptoms often start in the preschool years, but children tend to be diagnosed only after entering school, when the difficulties of meeting the academic

demands become apparent and the child exhibits behavioral or cognitive deficits. The male-female prevalence ratio of the disorder is 3:1 in children with equal male-to-female ratios in adults.¹¹ Because there is no standardized objective measure to make the diagnosis of ADHD, the diagnosis is made after a thorough clinical history. Review of standardized validated symptomatology questionnaires can help the diagnostic evaluation.

Patient evaluation regardless of the age should include gathering collateral information from parents, teachers, and in adults, partners or coworkers. When making the diagnosis, it is also important to screen for psychiatric and cardiac and other medical comorbidities to ensure that medications, if indicated, can be safely prescribed. The clinician should assess and compare the person's behavior with developmental norms in multiple settings including home, work, and school to ensure that function and impairment warrant intervention. Following the clinical diagnosis, the individual can be assigned a treatment that is tailored to their needs.

ATTENTION-DEFICIT/HYPERACTIVITY DISORDER ACROSS THE LIFE SPAN OF AN ATHLETE

Preschool and Elementary Years

ADHD is a common psychiatric disorder in both the general population and in athletes. Young athletes are a unique patient population. The preschool and elementary years

Age of Patient	Developmental Impact
Preschool	<ul style="list-style-type: none"> ● Behavioral disturbance
School-age	<ul style="list-style-type: none"> ● Behavioral disturbance ● Poor social interactions ● Academic difficulty ● Poor peer acceptance ● Comorbid conditions
Adolescent	<ul style="list-style-type: none"> ● Low self-esteem ● Poor social interactions ● Impulsivity ● Academic difficulty ● Smoking/substance use ● Comorbid conditions
College-age	<ul style="list-style-type: none"> ● Low self-esteem ● Academic difficulty ● Substance abuse ● Injury/accidents ● Relationship problems
Adult	<ul style="list-style-type: none"> ● Low self-esteem ● Not coping with tasks such as bill paying ● Unemployment or underemployment ● Relationship problems ● Driving issues ● Substance abuse ● Mood instability ● Imprisonment

are the most likely time for the diagnosis of ADHD. Young athletes may experience more problems with balance and coordinated activity.¹⁴ These children often present with behavior issues, which contribute to strain on the parent, child, and family; this strain may result in the subsequent development of depression, self-blame, and social isolation in the parent.

Hyperactivity is more common in children than in adults. In one quasi-experimental study comparing 34 male children (6–17 years) with ADHD with 41 children without ADHD, Johnson and Rosen found that male athletes with ADHD displayed higher levels of aggression, emotional reactivity, and frequency of disqualification.¹⁵ In one retrospective review, children with ADHD were also more likely to be injured than children without ADHD in noncompetitive play.¹⁶ Nevertheless, sports can be a good outlet for children with excess energy, and many kids find that playing sports is a place where they can excel. In addition, research has shown that exercise may decrease inattention and impulsive behaviors.¹⁷ Organized sports can be helpful in providing structure, expectations, and rules. Participation in sports has also been shown to decrease symptoms of anxiety and depression.¹⁸ The impact of a positive coaching experience is one way to build on the confidence of those struggling with ADHD who may have low self-esteem.

Middle School and High School Years

As athletes develop and enter adolescence, the unique challenges of this age group could emerge especially for those with ADHD. For middle school and high school athletes, with parental consent, the coaching staff should be informed about the diagnosis of ADHD and whether the athlete is taking medication. This important information allows the staff to monitor the athlete during practice and competition for potential negative side effects. The designated sport and position need to be considered in the overall treatment decisions for an athlete with ADHD. At this level of play, participation is more important than competition. Being part of a team, learning new skills, and enjoying physical activity typically outweigh the value of winning. This, in combination with academic requirements and success, needs to be considered when creating a comprehensive treatment plan.

College Athletes

Although symptoms of ADHD may be present before college, some students do not receive a diagnosis of ADHD until they are challenged by the academic expectations of the college environment. Greater independence, more temptations for unhealthy behaviors, a lack of parental regulation, lack of structure, and the need for more personal time management could lead to the surfacing of issues related to undiagnosed ADHD, all compounding the athlete's ability to succeed. Because by this age many people experience an abatement of the hyperactivity symptoms, the predominant presentation includes low attention, focus, and concentration. Previous school records, reports from people who know the athlete, and current stressors can all aid in making the diagnosis.

Professional Athletes

The prevalence of ADHD in elite athletes is challenging to determine because the stigma against mental health assessment and treatment is strong within this population.¹⁹ Unfortunately, poor focus, low frustration tolerance, low self-esteem, argumentativeness, and mood lability found in ADHD could impair the performance of an elite athlete, making the diagnosis and treatment of this disorder critical to their success. A review by Regnart and colleagues showed that mood disorders and substance use

disorders are also common in adult athletes with ADHD.²⁰ Screening for these conditions is an important part of the elite athlete's health management strategy.

ATTENTION-DEFICIT/HYPERACTIVITY DISORDER TREATMENT OPTIONS

The ADHD literature describes a wide variety of psychological treatments, with or without the use of stimulant and nonstimulant medication options. Psychological treatment interventions include supportive psychotherapy, cognitive behavior therapy, support groups, parent training, educator/teacher training, biofeedback, medications, and social skills training. The National Institute of Mental Health Multimodal Treatment of ADHD study showed that the use of stimulants was more efficacious than psychosocial management alone, combined treatment, and routine care in the community.²¹ Approximately 75% of those with ADHD note some benefit with psychostimulants,²² and thus, if diagnosed correctly, treatment of ADHD with a stimulant is a favored approach.

Stimulants act on the neurotransmitters that block the reuptake of dopamine and norepinephrine that are responsible for increasing attention and concentration. Stimulants also have a rapid onset, typically within 1 hour, with various durations of action depending on the formulation, giving patients an almost immediate effect. There is also some role for nonstimulant medications such as atomoxetine, bupropion, and guanfacine for patients in whom stimulants may not be an option (Table 2). The major benefit to nonstimulants is the absence of both psychological and physiologic abuse concerns. However, in clinical practice, many patients report that nonstimulant options are not as effective at reducing their symptoms as stimulants.

The age of the patient can affect the treatment recommendation. According to a review by Young and Amarasinghe, the most appropriate treatment of preschoolers is parent training.²³ For school-aged children with moderate impairment, group parent training and classroom behavioral interventions are typically recommended. For more severe impairment, these interventions are more appropriate when combined with stimulant medication. In considering the development of a comprehensive treatment plan, behavioral treatment can be particularly effective. Behavioral treatments for younger children should include consequences that are concrete, frequent, and coincide directly with the concerning behavior, and this allows the child to connect their negative behavior with the consequence. For older children, cognitive skills training can be taught to address social and achievement-related issues and will give the child some autonomy and ownership in their treatment.

Interventions that include the integration of home and school strategies, psychopharmacology, and some component of social skills training are best suited for middle school and adolescent children. For adolescence, treatment decisions cannot simply be imposed by an authority figure. Accepting medication needs to be negotiated and agreed on by the adolescent whose collaboration and agreement is critical to ensure treatment compliance.

Stimulant medication is generally first-line treatment of adults, but cognitive behavioral therapy coaching, group therapy, and marital therapy have also been found to be helpful. Regardless of the developmental stage, for patients to experience the highest level of remission and symptom abatement, treatments must also address the individual's daily adaptive functioning and their comorbid problems.

As individuals move into late adolescence and adulthood, treatments involving a cognitive behavioral perspective are likely to become increasingly helpful.²³ Recommendations regarding academic support and accommodations should be considered a necessary part of the treatment plan. Regardless of the age of the individual,

Category	Generic Name	Trade Name	Common Side Effects
Stimulants	Methylphenidate	Concerta, Ritalin, Metadata, Focalin, Methylin, Quillivant, Daytrana	Decreased appetite, weight loss, sleep difficulties, nervousness, irritability, hypertension, tachycardia
	Mixed dextroamphetamine-amphetamine salts	Adderall, Adderall XR, Mydayis	Decreased appetite, weight loss, sleep difficulties, nervousness, irritability, hypertension, tachycardia
	Dextroamphetamine	Dexedrine, Dextrostat	Decreased appetite, weight loss, sleep difficulties, nervousness, irritability, hypertension, tachycardia
	Lisdextroamphetamine	Vyvanse	Decreased appetite, weight loss, sleep difficulties, nervousness, irritability, hypertension, tachycardia
Nonstimulants	Atomoxetine HCL	Strattera	Fatigue, sedation, dry mouth, GI upset, increased sweating, hypertension. Rarely increased suicidality and hepatotoxic
	Bupropion	Wellbutrin, Zyban	Anorexia, tics, nervousness, potential seizures
	Guanfacine	Intuniv, Tenex	Sleepiness, drowsiness, dizziness, headache, irritability, low blood pressure, nausea, stomach pain, dry mouth, constipation, and decreased appetite

Abbreviation: GI, gastrointestinal.

clinicians should ensure that the goals and method of treatment are tangible and motivating. Thus, treatments should be modified at key developmental transitions using developmentally sensitive strategies that place the patient's most debilitating behaviors in the context of their level of understanding and ability to participate in their treatment.

COMMON MEDICATION SIDE EFFECTS

The benefit of stimulants must be weighed against the potential risks. Common side effects include decreased appetite, headache, gastrointestinal upset, and insomnia.

Cardiovascular side effects include rapid heart rate and increased blood pressure. There has been concern of sudden cardiac death from the use of stimulants for ADHD. However, review of the literature by Perrin and colleagues did not support this, and in 2008, a policy statement in the American Academy of Pediatrics recommended electrocardiogram screening only if there are concerning history or physical examination findings or a strong family history of predisposing cardiac conditions.²⁴ Prescribing clinicians should take a careful personal and family cardiac history and monitor the athlete's blood pressure and heart rate both before initiating treatment and during follow-up appointments (**Box 1**).

Another potential side effect of stimulants is the increased risk of heat illness, which is a common cause of death in athletes.²⁵ It is associated with physical activity and defined as the body's inability to regulate and offset the increase in core body temperature. The risk of developing heat illness increases for athletes on stimulants because of their effects on the body's regulatory system, interfering with normal thermoregulation by altering neurotransmitter activity in the brain. When prescribing stimulants to athletes, clinicians should monitor the athlete's weight and vital signs, alert them of the risk of heat illness, and educate them on the signs of heat-related illness, especially for those who participate in activities requiring sustained cardiovascular exertion such as cycling or cross-country running.

ATTENTION-DEFICIT/HYPERACTIVITY DISORDER AND CONCUSSION

There is an overlap in the clinical presentations of ADHD and concussion. In a cross-sectional study of 8056 high school and collegiate athletes, Nelson found that individuals with ADHD had a greater rate of baseline fatigue, poor concentration, insomnia, difficulty remembering, and balance problems, all of which can mimic the symptoms of a concussion.²⁶ This study also found that ADHD and learning disabilities place an athlete at 2 to 3 times the risk for repetitive concussive injuries. In addition, individuals with ADHD have been reported to have a continued decline on repeat neurocognitive testing scores after concussion.²⁷ A study by Biederman comparing 29 student athletes with ADHD with a historical sample of subjects without ADHD suggested that

Box 1

Cardiovascular screening

Personal History Questions

1. What is your history of heart murmurs, hypertension, chest pain, and palpitations?
2. Do you have a history of structural cardiac defects?
3. Have you ever had a cardiac event?
4. When was your last EKG? What were the results?
5. Have you ever had a history of any cardiac disease?
6. Have you ever had a history of any respiratory disease?

Family History Questions

1. Is there any family history of cardiac disease?
2. Has anyone in your family ever died young of a cardiac disease?

Cardiovascular Examination

1. Measure heart rate
2. Measure blood pressure
3. Cardiac auscultation looking for murmur
4. EKG if any of the aforementioned history is positive

Abbreviation: EKG, electrocardiogram.

this may be due to worsening inattention from ADHD rather than from concussion although this is a complex analysis, as concussion itself can cause inattention.²⁸ Furthermore, ADHD has been reported to slow the recovery of a concussion for up to 3 days.²⁹ Although recovery can be lengthened, some research shows that there does not seem to be a risk of developing chronic or worsened ADHD symptoms after concussion, whereas other research showed that children with ADHD had more significant symptoms of inattention after a closed head injury than controls.²⁵

All of these points make the evaluation and management of concussion more complex in this patient population. The prolonged recovery time and confusing clinical picture can make it difficult to determine when it is safe to recommend the athlete return to academics and to play. Therefore, clinicians should proceed with caution and consider a multidisciplinary approach. If at the time of injury, symptoms are well controlled, despite limited evidence, accepted practice is to continue medications.³⁰

SPECIAL TREATMENT CONSIDERATIONS FOR ATHLETES

When prescribing treatment of athletes, there are unique challenges that must be considered. The clinician caring for these athletes must customize care and treatment recommendations to accommodate an athlete's needs. Because the presentation, diagnosis, and treatment of athletes can change across the life span, the age of the athlete, their health status, student status, and the severity of their symptoms must be taken into consideration by the treating clinician. Except in very young athletes, stimulant medication with or without a psychological intervention is generally first-line treatment of ADHD. Because of high levels of intense exercise and activity, the physiologic and potential psychological effects of stimulants on athletes is a valid concern. When considering a stimulant medication, risk of diversion and potential for abuse should also be considered. For these reasons, long-acting agents should be considered as first-line stimulant treatment.

In children and adolescents, coaching that is structured and organized will result in the greatest benefit. Complicated instructions may need to be broken down into smaller pieces. Rules may need to be repeated. The home environment can play a major role, and homes that provide structure, calmness, and consistency can help a child or adolescent with ADHD perform their best.

Athletics and academics present an interesting dynamic; athletes with ADHD may be more attracted to physical activity than to academics because of inherent restlessness, internal reward-seeking benefits, and natural drive for competitiveness. Conversely, the struggle in the academic setting can lead to low confidence and poor self-esteem. It cannot be overstated that effective treatment not only improves quality of life and academic performance but also has demonstrated a decrease in the rate of substance abuse, driving errors, and the prevalence of comorbid psychological disorders. Balancing the dilemma between patient needs and the potential for serious side effects and unfair advantage in play due to stimulant use should be considered when deciding whether to recommend a stimulant or other nonstimulant strategies and psychological interventions.

In terms of the treatment of ADHD in college-aged or professional athletes, many sports leagues and organizations follow the guidelines established by the World Anti-Doping Agency, which allows therapeutic use exemption (TUE) to permit athletes to take stimulants if deemed necessary by their physicians.³¹ TUE is a newer policy, as stimulants were previously listed on the World Anti-Doping Agency–banned list due to their ergogenic potential. For athletes participating in college sports under the supervision of the National College Athletic Association (NCCA), stimulants require TUE in

order for athletes to take stimulants without sanction.³² There has been much controversy and confusion about the rules and regulations around the use of stimulants by these governing bodies. Although the nonstimulant option, atomoxetine, is US Food and Drug Administration approved for the treatment of ADHD, neither governing body requires a trial of atomoxetine before a stimulant trial.³³

Rates of use of stimulants by NCAA college athletes is not inconsequential. A drug use survey done in 2012 by the NCAA indicated that 4.3% of student athletes reported using stimulants with a prescription, whereas 6.3% of student athletes reported using stimulants without a physician's prescription, leaving the possibility that medication may be given to or sold to the athlete by friends and peers.³⁴ Abuse of stimulants for recreation and performance improvement is a valid concern.

Treatment decisions in the elite athlete are complicated by concerns related to fair competition. At this level of competition even the tiniest advantage can make a significant difference between winning or losing. When prescribing stimulants in professional sports, clinicians must follow the specific guidelines for therapeutic use exemptions outlined by professional organizations such as Major League Baseball and the National Football League.^{35,36} However, a bigger question is whether performance-enhancing agents should even be allowed at the elite level of sports. With the goal of fair play central to any sport, Reardon and Factor argue that all performance-enhancing agents including stimulants should either be completely prohibited or only prohibited during practice and play, thereby removing some of the ethical and medical concerns associated with their use.³³ Garner and colleagues argue that the banning of stimulants does not necessarily guarantee fair play and may contribute to poor social functioning and low self-esteem.³⁷ When making this decision, one should consider the evidence for increased risk of injury during play in inattentive athletes who are not being treated with effective medications.

The severity of symptoms and degree of impairment need to be considered when deciding whether to prescribe stimulants in a professional athlete. If medication is clinically necessary for an elite athlete, nonstimulant medication, such as atomoxetine, should be explored. For athletes with comorbid depression, there is some clinical evidence that bupropion, an antidepressant with some stimulant properties, may be helpful as an off-label for the treatment of ADHD.

Regardless of the age of the ADHD athlete, the designated sport and position need to be considered in the overall treatment decisions. Working with the athlete on the timing of the medication, such that it is most effective during academic sessions, should be explored. As a clinician, when providing treatment, the main goal is to develop a strategy that helps the athlete achieve success both academically and as an athlete, while remaining compliant with published sports governing body regulations. This customized strategy makes sense when the athlete is also a student and must obtain continued academic success in order to advance. However, when the athlete is an adult playing a professional sport, the use of stimulants should be used only after careful consideration. In making this decision, clinicians should consider issues related to the likelihood of performance enhancement, accuracy of the ADHD diagnosis, policies of sports governing bodies and potential for diversion and abuse.

SUMMARY

ADHD is a common neurodevelopmental psychiatric disorder that affects both athletes and nonathletes. Those with ADHD who participate in sports find that it can be mutually beneficial, as these individuals can naturally excel as well as have an outlet for symptom management. The diagnosis and treatment of ADHD is critical to the

optimal functioning and quality of life of those who struggle with this condition. The focus of treatment should be on psychological interventions with or without medications. The use of stimulants should be carefully reviewed and factor in the age, level of play and sport, and the health of the athlete. If stimulants are used, long-acting stimulants are preferred as first-line stimulant treatment.

Psychological interventions such as cognitive behavioral therapy, individual education plans; behavior modification therapy; caregiver support; parent teaching/training; and ADHD education for the patient, family, and coaches should be explored and recommended. In addition to these interventions, a comprehensive treatment plan should also include recommendations for healthy nutrition and physical exercise, as data have supported the benefit of both of these strategies. When impairment is moderate or severe, psychostimulant medication still remains first-line treatment of the abatement of ADHD symptoms. Treatment should not be avoided in student athletes. In professional athletes, treatment with stimulants should only be used after carefully weighing the risks and benefits, and nonstimulants should be carefully considered. Ultimately, pharmacotherapy with or without psychosocial interventions play a fundamental role in the management of ADHD athletes across their life span.

CLINICS CARE POINTS

- Younger children and athletes with ADHD, often present with comorbid behavioral problems.
- Unmitigated ADHD impacts performance in sports and academic/ vocational tasks.
- Age-appropriate psychosocial interventions should be considered along with medication management.
- Healthy nutrition, sleep hygiene and physical exercise related education should be included in a treatment plan for ADHD.
- Stimulant medications are highly effective and should be considered in athletes after judicious review of clinical presentation.
- Practitioners treating collegiate, amateur and professional athletes should make themselves aware of specific regulations of the specific sport governing bodies.

DISCLOSURE

The authors have nothing to disclose.

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