

Performance-Enhancing Drug Use in Adolescence

Abstract: *Despite inconclusive efficacy data and concerning safety data, the use of performance-enhancing drugs (PEDs) in the adolescent population is on the rise. Anabolic-androgenic steroids, growth hormones, stimulants, and erythropoiesis-stimulating agents are among the most widely known and studied prescription PEDs in the adolescent population. The purpose of this article is to describe the proposed mechanism of action, efficacy and adverse effects of these agents as well as discuss prevention measures and treatment considerations for those patients at risk for, considering, or currently using PEDs.*

Keywords: performance enhancing drugs; doping; adolescent

Although the overall use of performance-enhancing drugs (PEDs) has declined, the use of PEDs in the adolescent population is on the rise.¹ The Partnership Attitude Tracking Study (PATS) found that in 2013, 11% of teens reported using synthetic human growth hormone within their lifetime—a 2-fold increase since 2012, while steroid use increased from 5% to 7% in the same time frame.² The

most commonly cited reasons for use of PEDs in this population is to gain an athletic advantage over peers and to improve appearance. There exist little data, however, to support such use as it appears PEDs may not produce

known and studied prescription PEDs in the pediatric population, including proposed mechanism of action, efficacy, and adverse effects. The article will also discuss prevention measures and treatment considerations for those

... PEDs [performance-enhancing drugs] may not produce significant gains over those undergoing natural puberty utilizing evidence-based nutrition and physical training regimens.

significant gains over those undergoing natural puberty utilizing evidence-based nutrition and physical training regimens.^{3,4} The American Academy of Pediatrics strongly denounces the use of PEDs in the adolescent population.³ In addition to inconclusive efficacy data, use of PEDs carries significant risks including adverse health effects, the increased likelihood of future use of anabolic steroids and a shift in the focus of youth sports from pleasure and camaraderie to gaining a competitive advantage at any cost.³ The purpose of this article is to describe the most widely

patients at risk for, considering, or currently using PEDs.

Prescription Performance-Enhancing Drugs

The American Academy of Pediatrics includes the following substances among the most widely known and studied prescription PEDs in the pediatric population: anabolic-androgenic steroids, growth hormones, stimulants, and erythropoiesis-stimulating agents. Many of these drugs carry profound adverse

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effects and have inconclusive efficacy data. Proposed mechanism of action, efficacy and adverse effects for each class of these prescription PEDs are described below.

Anabolic-Androgenic Steroids

Anabolic steroids receive a great deal of attention among athletes due to their perceived effect in increasing muscle mass, speed, and agility.⁵ Between 1% and 12% of high school boys and 0.5% and 3% of high school girls report use of anabolic steroids with the highest rates found in male athletes competing in football, wrestling, and weight lifting.⁶ Athletes using anabolic-androgenic steroids have experienced increased muscle size and strength and higher fat-free mass indexes than nonusing athletes, but effects have not been found to persist beyond 6 weeks following discontinuation of use.⁶ Adverse effects of steroid use in the adolescent population include acne, hepatic dysfunction, suppression of the hypothalamic-pituitary-gonadal axis, unfavorable changes in the lipid profile, neurological changes (mania, aggression) and premature closure of the epiphyseal plates in the long bones.⁷

Growth Hormones

Growth hormone and insulin-like growth factor-1 regulate growth of bone and increase muscle strength and fat-free mass. Short-term use (6 days) of growth hormone in non-steroid-using athletes resulted in increased strength, power, aerobic performance, and respiratory muscle strength.^{8,9} However, a systematic review of the effects of growth hormone on athletic performance concluded that while increases in lean body mass may result, use may not improve overall strength and could actually worsen exercise capacity.¹⁰ Long-term use (greater than 30 days) of growth hormone for improved athletic performance has not been studied.¹⁰ Adverse effects from the use of growth hormone include hyperglycemia, insulin resistance, edema, myalgia/arthritis, gynecomastia, cardiovascular disease, and intracranial hypertension.¹¹

Stimulants

Stimulants, including amphetamine, D-methamphetamine, and methylphenidate have the capacity to increase alertness and improve endurance, anaerobic performance, and reaction time.¹² Past-year nonmedical use of amphetamines in high school students was reported at 6.2% in 2015 and the use of stimulants in collegiate student athletes has increased 3-fold in recent years.^{13,14} This class of PEDs is of particular concern due to therapeutic use exemptions that allow athletes to take these otherwise banned medications for medical conditions such as attention-deficit/hyperactivity disorder. In addition to the risk of potential addiction, amphetamine stimulants have a myriad adverse effects, including hypertension, tachycardia, heart attack, headaches, tremors, insomnia, anxiety/panic attacks, aggression, and psychosis.¹⁵

Erythropoiesis-Stimulating Agents

Erythropoiesis-stimulating agents such as erythropoietin and darbepoetin alfa are thought to improve athletic performance through enhanced oxygen delivery to active muscle tissue.¹⁵ Use of these agents has been shown to increase aerobic power and physical exercise tolerance.¹⁶ The health risks of erythropoiesis-stimulating agents occur as a result of increased blood viscosity and include heart attack, stroke, deep vein thrombosis, and pulmonary embolism.¹⁵

Strategies for Decreasing Prescription PED Use Among Adolescents

Despite inconclusive efficacy and concerning safety data, many adolescents continue to use PEDs. Various strategies have been employed to dissuade PED use, most commonly screening, punishment, and didactic education.¹⁷ While didactic education programs exist to inform athletes of the potentially dangerous consequences of PEDs, many athletes choose to dope despite being aware of the possible consequences.¹⁸ In

fact, a study of German adolescents found that PED use is more prevalent among individuals with increased drug use knowledge.¹⁹ A potential hypothesis for this lack of efficacy is the idea that these education programs target drug use behavior rather than underlying athlete attitudes. To illustrate, a survey of 198 Olympic athletes evaluated the motives, fears, and consequences regarding use of PEDs.²⁰ The study found that 98% of these elite athletes would use PEDs if they knew they would not get caught and use would result in victory in their sport. When asked the same question with the caveat that the athlete would die within 5 years, 61% still reported they would use the PED. Another study, of high school football players, found that a risks-only education program failed to increase student athletes' belief of any possible untoward consequences of PED use.²¹ These findings suggest that fear-based counseling and education may not be effective when discussing the use of PEDs with competitive athletes.

Drug testing has also been used to detract athletes from PED use. In the high school setting, this approach has mixed results. The Student Athlete Testing Using Random Notification (SATURN) study assessed the effects of random drug testing among high school athletes.²² While the study showed potential benefit in reduction of prior year use of drugs, it also found negative effects on specific potential substance-use mediators, like less belief in the athlete's own athletic competence and belief of authorities being less opposed to drug use. Because of the lack of solid evidence for their effectiveness, the American Academy of Pediatrics does not support widespread implementation of school-based drug testing.²³

More recent approaches to deter or treat affected individuals relate to changing attitudes and orientations toward the intended goal of use (enhanced performance, improved physique, etc).¹⁷ The transtheoretical model of behavior change and motivational interviewing (MI) technique have been proven effective when applied to problematic behaviors (smoking,

alcohol abuse, etc) and their application may be beneficial when counseling competitive athletes on the use of PEDs. An article by Johnson et al¹⁷ thoroughly describes how these frameworks apply to this population in a clinical setting. The authors argue that many athletes who are contemplating or currently use PEDs require intervention methods that match their specific needs and readiness to change. These individuals do not respond to coercion or persuasion, so using MI to help the athlete identify discrepancies between their behavior (or contemplated behavior) and their values, motives, and interests may be more effective in the behavior change process. Important concepts emphasized in the application of MI include provider empathy, discrepancy development, rolling with resistance and supporting self-efficacy.

Conclusion

Performance-enhancing drug use is a problem in adolescent athletes. By definition, outperforming others is a goal of competitive athletics and thus, PED use may be perceived as rational behavior in a competitive athlete's mind. Because it has been found that counseling focused only on the risks or consequences of PEDs are ineffective, counseling should instead emphasize the lack of efficacy of such agents where it exists. Motivational interviewing should be employed to explore the goals and values of the athlete, including where they want to go in life after sport. During this process, discrepancies are developed and motivation for avoiding or altering drug use behavior build. At the same time, this process builds confidence in the athlete's ability to enhance their natural ability through undergoing puberty and utilizing evidence-based nutrition and physical training regimens. Health care providers should assist in encouraging this self-efficacy through the provision of evidence-based, safe alternatives to PEDs or directing athletes to resources where these alternatives can be accessed.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. **AJLM**

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