

Sports and Performance Enhancement

General Stats and Information:

- Substance use patterns vary widely based on sport, level, gender, sexual orientation, ethnicity, country, and other demographics; however, they are generally thought to be underestimated due to relying on self-report and urine testing data
 - Despite this, the most commonly reported substances used by elite athletes include alcohol, caffeine, nicotine, cannabinoids, stimulants, and anabolic-androgenic steroids (AAS)
- Due to the ergogenic aspects of performance-enhancement substances (PESs) use rates continue to increase while athletes risk their health, adverse social interactions, legal ramifications, psychological turmoil, and other consequences of getting caught
 - Ergogenic and ergolytic refer to performance enhancement and performance impairment, respectively
- Historical scandals in international cycling led to the creation of the World Anti-Doping Agency (WADA) in 1999 to address doping concerns through accredited labs and expansive testing procedures
 - Adverse Analytic Findings (AAFs) is a WADA report identifying prohibited substances, their metabolites, markers, or evidence of a prohibited method
 - The top 3 substances identified were anabolic agents, stimulants, and diuretics
 - The WADA Code/Prohibited List is updated annually to promote fair and ethical competition
 - AASs make up half of all AAFs in drug testing

Reasons for Use:

- Roughly 30% of athletes using AAS develop a use disorder believed to be caused and/or perpetuated by 3 main factors: to maintain a certain physique (as severe as body dysmorphia), to suppress the hypothalamic-pituitary-gonadal axis and slow down testosterone production, or to reverse common side effects of AAS use
- Broadly, PESs improve power, endurance, speed, aggression, agility, alertness, and focus, and reduce fatigue, injury healing time, and percentage of body fat
- Research suggests that up to 40% of anti-doping rule violations are related to unintentional use, which is thought to be related to the lack of regulations on over-the-counter supplements
 - Anywhere from 40 to 100% of athletes utilize supplements in their training and recovery, depending on their sport and competition level
 - A meta-analysis found that 46% of college athletes and 59% of other elite athletes used supplements
 - The International Association of Athletics Federations World Championships in track and field reported 86% supplement use with 71% being used to improve recovery, 52% to improve health, and 46% to improve performance
- Given the exposure of particular athletes, social media, their fitness appearance, and overall performance and status may also be contributing factors to the reasons for their use
- Lastly, athletes are just as vulnerable to psychiatric illness and disorders as the general population, and with the known barriers to care, untreated psychiatric illnesses are known to be associated with substance use

Substances and Performance:

- PESs cover a wide range of substances including anabolic-androgenic steroids (AAS), selective androgen receptor modulators, peptide hormones, growth factors and related substances such as erythropoietin (EPO) and growth hormone; hormone and metabolic modulators, such as selective estrogen receptor modulators (SERM); masking agents; and other substances
- Direct doping is when an athlete administers endogenous or synthetic androgens
 - Classically, they bind to DNA receptors, altering gene transcription, causing a cascade of events that ultimately produce more proteins and muscle hypertrophy
 - Due to these cellular changes, this is how some results like myonuclei numbers can remain despite abstinence
- Indirect doping is administering nonandrogenic drugs to increase endogenous testosterone for improved performance
 - Typically, this includes human chorionic gonadotropin and luteinizing hormone, antiestrogens, like estrogen receptor antagonists or inhibitors, or androgen precursors, such as dehydroepiandrosterone or androstenedione
- Gene doping refers to the transfer of cells or genetic elements or the use of pharmacologic or a biological agent to alter gene expression
 - This is a developing model of performance enhancement that could potentially target specific genes for highly specific outcomes
 - For example, altering insulin-like growth factor (IGF)-1 and myostatin genes to improve strength, or the angiotensin-converting enzyme (ACE), EPO, or peroxisome proliferator-activated receptor (PPAR) genes for endurance
- A similar methodology that is becoming increasingly popular is selective androgen receptor modulators (SARMs), such as MK-2866, RAD-140, and LGD-4033
 - They can bind to tissue-specific areas to promote transcription and gene expression of skeletal muscle and bone without the undesired androgenic effects, like hirsutism, clitoromegaly, and gynecomastia
- Hypoxia-inducible factors (HIFs) are pharmacologic and/or genetic strategies that use hypoxia to increase EPO and stimulate red blood cell proliferation, leading to endurance and aerobic power
- Growth hormone responses are mediated through IGF-1 and 2 release which have downstream roles in decreasing fat mass and increasing lean body mass, bone mineral density and growth, protein synthesis, maximal oxygen uptake, maximal heart rate, and power output, and sensitivity in skeletal muscle
- Metabolic modulators regulate metabolic pathways like PPAR and adenosine monophosphate-activated protein kinase (AMPK) to alter their resultant effects, including elevated fatty acid oxidation, reduced obesity and insulin resistance, exercise-induced muscle remodeling, and increased performance
- While AASs and growth hormones are what usually come to mind when thinking of PES, it should be noted that stimulants, caffeine, β 2 agonists, diuretics, opioids, and cannabinoids can also have ergogenic effects depending on the sport and context

Rates of Use:

- The most common AAFs from WADA laboratories from 2013 to 2017 were anabolic agents (48%)
- SARMs, hormones, and metabolic modulators are continue to increase in use
 - Specifically, low-concentration positive tests of anabolic agents, such as turinabol, clenbuterol, and stanozolol, along with the SARMs ostarine, RAD-140, and LGD-4033 and the hormone and metabolic modulatory GW1116
 - Their low concentrations may be due to micro-dosing practices, where small doses of substances or PESs are utilized to avoid detection and adverse effects, but still provide athletes with their predefined benefit
- The average reported collegiate AAS use for men and women was 0.4%, further raising the question of testing modalities and accuracy
- The lifetime or current prevalence of PES use varies greatly (1–70%) depending on the sport, substance, detection method and definition used
 - Rates are higher in power and collision sports compared with other sports, which showed that 37.5% of male and female competitive bodybuilders and 66.7% of elite male powerlifters reported AAS use
 - In a study, 9.1% of retired NFL players admitted to using AASs during their professional careers, with the highest rates among offensive (16.3%) and defensive (14.8%) linemen

Signs and Symptoms of Use:

- Men: Reduced testicular size, low sperm count, balding, prostate cancer risk, painful urination, breast development (irreversible except through plastic surgery), infertility
- Women: Facial hair, voice deepening, baldness, enlarged clitoris, menstrual dysfunction
- Both genders: Weight increase, oily hair/skin, cysts, high cholesterol & blood pressure, heightened sexual desire, acne, shaking, behavioral changes (aggressiveness), stretch marks, bloating, poor mood, increased injury rates, cognitive impairment, potential psychosis
- Withdrawal: Depressed mood, weakness, fatigue, aches, insomnia, weight loss, restlessness, insomnia, mood swings
- Most severe systemic effects are death from cardiovascular disease, sterility, masculinization, addiction, liver problems, renal issues, immune system changes, psychiatric manifestations, and hypothalamic-pituitary-testicular axis disturbances
- PES use is typically split with periods of non-use and/or periods where other substances are used to mask PES side effects
 - Some of these mitigating substances include diuretics, benzodiazepines, growth hormone, insulin, or insulin-like growth factor 1
- Another class of substances used is antiestrogenic to mitigate the antiestrogen effects like aromatase inhibitors or selective estrogen receptor modulators (SERMs)
 - Aromatase inhibitors limit the conversion of testosterone to estrogen, thereby increasing testosterone and androstenedione levels and promoting anabolic effects
 - SERMs target specific tissues and have the potential to elevate testosterone

Testing:

- Athletic trainers and team staff can aid in early detection of use/misuse with open-ended questioning
 - It is also equally important to engage athletes' social circles in their care while moderating their confidentiality
 - This expands the role of mental health providers to psychoeducate not only the players and the staff but also allow them to advocate for the athlete's care and support
- Annual preseason physicals and training are ideal times for screening and psychoeducation of PES use
 - Classically, there is a preseason physical where they monitor behaviors, have self-report screeners, urine screens, medical exams, and open-ended questions with other touch points across the season during transitions and acute events (injuries, trades, transfers, etc.)
- Research-backed screening instruments include:
 - The International Olympic Committee (IOC) Sport Mental Health Assessment Tool-1 (SMHAT-1)
 - Tobacco, Alcohol, Prescription medication, and other Substance use (TAPS)
 - Drug Abuse Screen Test (DAST-10)
- The most common ways of determining PES use are through competition-day urine drug tests and self-reported surveys, which are believed to underestimate the overall use of PES
 - To avoid detection, athletes have been known to use unknown substances or substances with unknown structures/metabolites ("designer steroids"), enzyme inhibitors, masking agents to lower other drug concentrations, and naturally occurring substance substitutes
- Other testing strategies like the biological passport, hair testing, interval testing across and outside the competitive season, attitude scales, and direct/indirect questionnaires to athletes, staff, and their social spheres are being considered for more accurate representation of current and past use
 - Some data suggests that increasing the frequency of drug testing may act as a deterrent and reduce overall substance use in athletes
- The Athlete Biological Passport (ABP) is a developing testing model that gets routine blood, urine, and other specimen samples from an athlete over time, to establish their biomarkers' baselines and evaluate any future deviations for the use of PESs
 - Effectively, this testing system would be utilized to assess and pinpoint the effects of any PESs rather than detecting the PES itself, prompting further testing
 - An example of this in a steroidal model would be collecting testosterone, estrogen, and other hormonal levels, and establishing the athlete's baseline T/E ratio, such that a deviation of this may prompt further testing for steroids or other PESs
 - This is thought to also be beneficial due to emerging micro-dosing practices, where small doses of PESs are utilized to avoid detection and adverse effects, but still provide athletes with their predefined benefit
- Similarly, microRNAs may be utilized in the near future to assess for gene doping and the consequences of altering genetic material
 - MicroRNAs (miRNAs) are circulating small noncoding RNAs that regulate various biological processes in several body fluids and can be a new class of biomarkers for the detection of gene activity
- Most recent models balance training sports staff and integrating mental health clinicians to work with teams yearlong for screening and potential treatment when indicated

- Due to simultaneous use (i.e. polysubstance use) cannabis, alcohol, and nicotine screeners should be reviewed
- Anyone who tests positive on a drug test or screening tool should also be assessed for a psychiatric condition with a screener (GAD7, PHQ9, ASSQ)

Treatment:

- As with the general population, treatment for substance use disorders in athletes consists of many of the same principles, typically brief interventions including various forms of therapy and potentially medications, when appropriate
- Psychoeducation should always be a starting point for treatment to provide the athlete with the appropriate information, to ensure they can make educated decisions about their care and future
- Motivational interviewing and motivational enhancement therapy are core principles for work and understanding individual's reasons and ambivalence about their use
- Contingency management also has research and studies promoting its use of a reward-based system when treating addiction
- With the advancements in technology, there are direct and web-based individual feedback tools and programs that can help align with an athlete's goals of care
- Group therapy has been effective when providing care for athletes with use disorders, with the main drawback being concerns around confidentiality, and therefore athletes' willingness to participate
 - A similar dynamic includes support system involvement, utilizing an athlete's social circle to aid in their compliance with treatment, and continued help
- One unique element about anti-doping treatment is that self-efficacy and adaptive motivation are protective factors against doping, so instilling and strengthening these in athletes are psychological targets of treatment
- Treatment is always enhanced with a multidisciplinary team (medical, psychiatric, and substance use providers, amongst other allied health providers)
- It is also important that when treating use disorders, comorbid psychiatric disorders like anxiety disorders, major depressive disorder, ADHD, and others are identified and appropriately treated
- When treating use disorders or psychiatric conditions in athletes, providers must understand WADA's policies, the prohibited substances for the athlete's sport, the Therapeutic Use Exemptions (TUE), and their effects on athletic performance
 - A research study reviewing TUEs in professional cyclists from 2020-21 demonstrated that ADHD was being undertreated
 - This was speculated to be due to stigmatization, negative conceptions of performance-enhancement allegations, and medicolegal recriminations
- Lastly, as providers and a society, we need to change the way we stigmatize substance use
 - Ascribing characteristics of people's morals and decisions further devalues and damages those who are suffering from a use disorder
 - Statistics show that up to 40% of those who are sanctioned for anti-doping rule violations (ADRV) did not intend to use an illicit PES but were punished due to the strict liability of WADA's policies

- It is pertinent to emphasize that those with use disorders are people who need help and treatment, regardless of how or why they started and developed their use disorder
- Providing psychoeducation to everyone about PES use, its effects, and treatments can help combat the stigmatization and ignorance of those suffering from their use, as well as those aiming to help and treat individuals
 - Stigma and discrimination lead to people concealing their use, compounded with the difficulty of finding adequate care, and fear of criminal liability in healthcare providers, which makes PES use treatment very difficult and at times, ineffective
 - Overall, the punitive approach, supplemented with media and societal judgment, leads individuals to remain in their use, rather than seeking help, further complicating and damaging their health
- In conclusion, while data does exist about athletes and their PES use, holistically, more research needs to be done to better understand the plague of PES and their role in sports and sports culture, to help the advancement of testing protocols and treatment modalities

Resources

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