

## Exogenous Supraphysiological Doses of Anabolic-Androgenic Steroids: Controversial and Reciprocal Effects on Performance and Organs

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Anabolic-androgenic steroids (AAS) are synthetic derivatives of male sex hormone called testosterone. The legal and illegal use of these substances has progressively gained popularity because of enhancing athletic performance (strength, power, speed, endurance and aggressiveness) and appearance (hypertrophy and making weight for fitness and physique). However, AAS abuse also prevalent in people who recreationally do resistance training. Historically, AAS were first developed in the late 1930s in an endeavor to treat hypogonadism and chronic wasting [1]. Since the 1970s athletes abused AAS for high performance in such sports as weight lifting, body building, powerlifting and track and field [2]. Now, amount of these drugs abusing has reached alarming dimensions. Many athletes acclaim that they will not success without them [3]. While, above mentioned beneficial effects have not been approved by scientists and expert researchers and were questioned for decades. Of course, effectiveness of these drugs depend on many factors including doses, combinations of AAS, type of abuse, duration, type of training, individual differences, fitness level or training status. On the other hand, there is no controlled study showing that testosterone derivatives significantly increase lean body mass or strength in people. Few studies with a lot of limitations demonstrated that supra physiologic doses confirm the efficacy of these substances [4,5]. One of the most important goals of sports is fair play in competition based on ethics and keeping the athlete's health. Sport organizations and associations such as international Olympic committee (IOC), world anti-doping agency (WADA), and national strength and conditioning association (NSCA) reject the abuse of any performance enhancing drugs and substances in order to ergogenic aids [6]. Because, these shortcuts is against sport spirit and induces unequal condition for athletes participations in events and competitions. Moreover, the athletes who abuse AAS, it is hard to continue training naturally.

During last decades scientist in scope of pharmacology tried to increases the anabolic properties (tissue building) of the AAS and minimize the androgenic ones (sex related) [3]. However, they failed to eliminate the androgenic effects because of two reasons: First reason is lack of capability to discriminate between anabolic receptors or androgenic receptors on the tissue cells. Second, likely anabolic and androgenic receptors are same. Based these, positive and negative effects of AAS are happen together.

AAS used as oral and injection forms. Oral forms of AAS have more toxicity, but, latter causes less toxicity and are present as water soluble and oil soluble. Water soluble types have short-term effects. In turn, oil or fat soluble are long-lasting and have a longer half-life. AAS effectiveness in athletes requires heavy resistance training and some studies reported improved performance in AAS users with experience of weight training other than novice ones [3]. Because, experienced athletes lift heavier loads and therefore, more stimulation and physical stress impose on skeletal muscles. Concurrently, up-regulation of steroids receptor is happen and intra-muscular protein synthesis is enhanced and protein degradation is inhibited (anti-catabolic effect of AAS).

Physiological doses of AAS has clinical and therapeutic applications and prescribed by physicians for these reasons: hormone replacement therapy in men aimed to delayed maturation, testes injury, hormone replacement therapy in women with purpose of treatment of sexual infantilism and improving libido, treatment of gynecologic disorders. Other clinical benefit of AAS are increased protein synthesis, decreased anemia via stimulation of red blood cells production, overcome on osteoporosis and finally growth stimulation in non-matured boys.

Abuse patterns of AAS are cycling, pyramiding and stacking. In the first pattern, drugs abuse in a period and following that consumer stop tacking of it. Second pattern include gradual increasing dose of AAS until gaining to peak and then gradual decreasing dose to end of cycle. Third pattern is composed of regimen of AAS combination more than one substance. This pattern principally includes concurrent oral and injective type of AAS and has more side effects than others at high doses.

Against good effects of AAS in clinical cases (physiological doses), Athlete's health is influenced by AAS abuse (supraphysiological doses). Victory in championships or winning must not be achieved any way. On the basis of previous studies, it has been showed that the abuse of AAS may be accompanied by irreversible and chronic organ damage [2]. Among the most common side effects of AAS are gynecomastia in males and masculinization in women, cardiovascular risk factors (hypertension, atherosclerosis, blood clotting, thromboembolism, intra-cardiac thrombosis, stroke, arrhythmias, cardiomyopathies, increases in hematocrit, decrease in HDL cholesterol, impaired endothelial function, vasospasm and sudden cardiac deaths), hepatic disorders and toxicity (jaundice, carcinoma, hepatic neoplasms, cholestasis, peliosis, adenomas, higher activity of liver enzymes (AST, ALT, AP, LDH and GGT)). Musculoskeletal injury (tendon and ligaments tears), renal problems (cholemic nephrosis and kidney failure), immunological disorders (decreases in IgA, IgG), endocrine disorders (HPA axis changes, decrement in thyroid stimulating hormone (TSH), triiodothyronine (T3), thyroxine (T4), follicle stimulating hormone (FSH), luteotropic hormone (LH), estrogen, progesterone, increased possibility of type 2 diabetes, insulin resistance and glucose intolerance). Psychological disorders (reckless behavior, exaggerated self-confidence, aggressiveness, depression, suicidal intentions and psychotic symptoms). Other adverse effects are voice changes, hair growth on the face, amenorrhea and reduced fertility

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and increased libido in women and hypogonadism, atrophy of testes, oligospermia, azoospermia, abnormal sperms, reduced fertility and libido and acne in men [2,6-11].

Moreover, AAS withdrawal may lead to serious health threatening problems such as uncontrolled emotions, aggression, anxiety, depression, appearance of mood changes, weak thinking, headache, fast weight loss, reduced appetite, sleep disorder, desire to again abuse of AAS (they engaged psychological disorder that known psychological dependence), immune suppression and increased susceptible to flu and cold. During stop taking AAS, the catabolic effects of cortisol are enhanced quickly that previously in time of AAS use were suppressed their receptors. This catabolic condition is called the rebound of cortisol [3]. Increased secretion of cortisol cause immune suppression and finally individual weakness.

In summary, AAS prevalence among elite and recreationally athletes is a widespread concern because of insufficient evidence in regard to confirming possible performance improvements and on the other hands, the multitude of serious adverse effects with unknown symptoms and signs. It seems that positive effects of AAS over estimated. In turn, negative effects of these drugs underestimated. The current approach sounds the alarm bells for health problems. Professional sport organizations and sport governing bodies should place an emphasis on higher education of athletes, coaches and conditioning experts to gain more knowledge, higher skills and training technics for better designing exercise programs and optimizing nutritional strategies.

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