

Commentary - Increasing abuse of anabolic steroids and chemsex drugs as performance and image-enhancing agents

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Anabolic Androgenic Steroids (AAS) are a family of synthetic “Appearance and Performance Enhancing Drugs” (APED) derived from natural sex hormones, such as testosterone and its derivatives or precursors (e.g., dihydrotestosterone)¹. Whereas testosterone is the androgen responsible for the development of male secondary sex characteristics and elicits both anabolic and androgenic effects, AAS mostly simulate the anabolic effect of endogenous testosterone, and induce only partial androgenic effects². In the 1930s, anabolic steroids were shown to facilitate muscular growth—hand consequently became rapidly popular among bodybuilders and other athletes, and were already widespread in the 1960s. AAS have been and still are among the doping agents most frequently misused by athletes, regardless of the type of sport, both in preparations containing natural anabolic drugs [e.g., testosterone and dehydroepiandrosterone (DHEA)] and in those with synthetic substances (e.g., dianazole, nandrolone, stanozolol and tetrahydrogestrinone)^{2,3}. To avoid AAS abuse, the World Anti-Doping Agency (WADA)⁴ included these compounds in the list of substances whose consumption is prohibited in sport competition with the exception of medical reasons for use. Whereas years ago, AAS were misused only by elite athletes, nowadays this mistreat is not confined to the Olympic and professional sports world, but it also involves amateur athletes and adolescents and young adults interested in appearance and performance enhancement⁵. Indeed, AAS misuse appears to be closely linked to the aim of achieving perfection, in an attempt to constantly produce the best sporting performance and improve one-physical appearance. Remarkably, the reasons for using AAS are very different for men and women. Women and adolescents often use AAS for aesthetic and weight lifting purposes

(e.g., models in fashion shows or fashion news reports), while men are more likely to use AAS for physical performance or sexual power in association with other substances. In this latter concern, it has been demonstrated AAS are often taken in combination with psychotropic and non-psychotropic drugs in the context of “chemsex”⁶, in which heterosexuals and homosexuals have sex under the influence of stimulating substances. In these contexts, poly-drug use has been shown to be frequent^{7,8}. Among most used compounds, methylamphetamine, cocaine or synthetic cathinones and gamma-hydroxybutyric acid (GHB) or its prodrug gamma butyrolactone (GBL) are used in chemsex parties to increase libido alertness and stimulation, phosphodiesterase V inhibitors⁹ (e.g., sildenafil, tadalafil and vardenafil) to improve sexual performance and avoid unpleasant sexual side effects of cocaine hangover (e.g., erectile dysfunction) or those of AAS, which are one of the main causes of iatrogenic damage to the hypothalamic-pituitary-testicular axis (infertility, sexual disorders and erectile dysfunction)¹⁰. Addiction is not only a problem related to drugs of abuse used in this context, but also a major drawback of anabolic steroids and affects one third of users (millions of people worldwide)¹¹. Similarly to psychotropic drugs¹², anabolic steroids induce euphoria, aggressive behavior, irritability, libido alteration, manias and psychosis. Action at the central nervous system is amphetamine-like: the subject feels a sensation of well-being and joy, does not feel boredom during training and does not feel fatigue. With time and increasing doses, euphoria turns into aggressiveness and antisocial behavior. Up to 80% of users are aggressive and violent during the period of use¹³. Indeed, various sources have pointed out that AAS abuse frequently results in feelings of hostility that may

even lead to acts of violence. Others have indicated that AAS users are also likely to abuse alcohol and/or various illegal drugs. In that regard, it is worth noting that substance abuse has been known as a major risk factor for violent behavior; hence, the violent acts committed by AAS users could actually be caused by abuse of other drugs, in addition to AAS¹⁴. Still, it is quite significant that the risk of having been convicted for a weapons offense or fraud has been found to be higher among those who tested positive for AAS¹⁵. After all, studies dating back to 1980s suggest that AAS may cause the development of manic or hypomanic syndromes, at times coupled with depression symptoms and suicidal ideation; quite seldom, successful suicide attempts have been recorded, particularly during AAS withdrawal¹⁶⁻¹⁸.

For this reason, in some EU countries including Italy, nandrolone, one of the most misused synthetic AAS, has been included in the law banning psychotropic drugs in 2010 by the “Commission for the supervision and control of doping and health protection in sports activities” in agreement with the competent advisory entities of the Ministry of Health, as concrete risks of developing serious mental addiction have been demonstrated¹⁹. AAS short-term clinical and biochemical side effects are well established and involve cardiovascular, reproductive, endocrine, hepatic, osteoarticular and neuropsychic systems^{20,21}. Also significantly, impaired resting-state functional connectivity has been observed in AAS users, particularly between brain network nodes playing a fundamental role in regulating emotional and cognitive states, including the amygdala, the default mode network, the dorsal attention network and the superior and inferior frontal gyri, and the anterior cingulate cortex in AAS users. Such findings related to brain connectivity are arguably consistent with the typical neuropsychiatric and cognitive effects of prolonged AAS use, which also include dysregulation at the emotional and behavioral levels²².

Moreover, the interactions between AAS and some types of GABAA receptor in the central nervous system has been observed in studies carried out on human cells; that could explain the sense of unrest and anxiety reportedly experience by users²³. According to results from animal studies, AAS can increase serotonin concentrations in mood-related areas of our brain, as well as dopamine in areas associated with the sense of reward²⁴. Prolonged or chronic AAS use may lead to dysfunctions of such reward patterns²⁵. Reward mechanism dysfunction has been observed in rats

which had been administered nandrolone twice a day for four weeks, coupled with decreases in dopamine, serotonin, and noradrenaline levels in a reward-related area of the brain, the nucleus accumbens²⁶.

Other long-term side effects are uncertain, but may include heart, reproductive and especially liver problems. Increased bilirubin, alkaline phosphatase and transaminases are the main biochemical changes that can be detected in the blood. Prolonged administration can cause the appearance of peliosis hepatis²⁷, a pre-tumoral alteration characterized by blood microcysts, the breakage of which can induce serious hemorrhages and morpho-functional disorders. Cancers are more frequent in young or young-adult subjects and histologically present as hepatocellular carcinomas. AAS use and abuse is therefore becoming an emerging problem especially for certain sections of the population who just want to improve their physical appearance or sexual performance and end up suffering from acute intoxication or developing cancer.

Similarly to AAS, adverse effects of psychotropic drugs and GHB abuse may include loss of consciousness, hallucinations, amnesia, and coma while phosphodiesterase 5 inhibitor abuse can produce several adverse effects, including potentially fatal cardiovascular events^{28,29}.

Considering the increasingly simultaneous use of all these compounds as “Appearance and Performance Enhancing Drugs” (APED), synergistic acute chronic and fatal side effects can be taken into account and their misuse has been linked to an increased risk of death and a wide variety of cardiovascular, psychiatric, metabolic, endocrine, neurologic, infectious, hepatic, renal, and musculoskeletal disorders³⁰. This undoubtedly poses a serious health threat for users, who allegedly think they are improving their health and aspect while they are severely compromise it³¹. This emerging trend could represent a growing public health issue since the AAS can be obtained easily and at an affordable cost on the Internet, although often the quality and safety of the preparations are questionable.

In conclusion, we wish to draw the attention to the numerous complexities inherent to the growing trend of APED use and the root causes behind their alarming popularity; as a matter of fact, in that regard, research has unveiled the key role played by psychological disorders believed to arise from body image issues and ensuing APED use. Body image disturbance may in fact be the

most significant psychiatric disturbance that has been linked to APED use³². A wide array of symptoms has been observed, namely: abnormal concerns about outward appearance, i.e., worries (liable to turn into obsessions) about physical attributes and looks, recurring behavioral patterns of body assessment and avoidance, and aversion to changes in appearance. Such APED-associated symptoms have been shown by several surveys to be closely related to each other, and often conspicuously matching dynamics linked to patterns of comorbidity³³. In addition, it is worth bearing in mind that body image disturbance among adolescents is deemed to be predictive of intentions for future illicit APED use³⁴. From a psychological perspective, “enacted” body image is a multi-layered process of sense-making and coming to terms with one’s perception of self, which the individual undertakes while attempting to fit into specific situations³⁵. Substances such as APED, which are thought to make that demanding process of “adapting” easier, may be extremely attractive to many. After all, body image-related concerns about the way one looks currently affect people of virtually every age: according to Tatangelo et al³⁶, between 20 and 70% of children under six feel dissatisfied with their bodies to some extent; body dissatisfaction rates are quite stable throughout one’s lifespan. As institutions worldwide set out to battle the scourge of substance abuse, the whole scientific community and government bodies need to look closely at mental health root causes as well. Only a broad-ranging and timely set of measures and approaches will make it possible to stem the APA/APED health threat, so that the non-negligible abuse liability and dependence risks associated with such substances are effectively faced.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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