

Anabolic Steroids

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March 2009

Introduction

Anabolic steroids are a diverse group of drugs that mimic, to varying degrees, the actions of endogenous testosterone. For the last 50 years the use of these drugs within elite sport (along with a diverse number of other performance-enhancing substances) has been a concern for sports authorities. In 1996 Bhasin et al., definitively demonstrated that supraphysiological doses of the anabolic steroid testosterone enanthate, given to eugonadal men, were capable of significantly increasing muscle size and maximal voluntary strength — an effect that was augmented by strength training¹. It is important to note, however, that rigorous evaluation has been limited, for the most part, to the injectable testosterone esters rather than other types of anabolic steroids.

For the last 50 years the use of these drugs within elite sport (along with a diverse number of other performance-enhancing substances) has been a concern for sports authorities. Indeed, it is an issue that has intermittently gripped the media and the general public alike, usually as a result of the fallout from high-profile doping cases such as that of Ben Johnson at the Seoul Olympics in 1988 and, more recently, the BALCO scandal². However, the reality is that use of these drugs in elite sport represents only a tiny fraction of the total number of users in the general population. In fact within the United Kingdom, thousands of individuals take these drugs as a core component of their training, predominately with the aim of enhancing their physique and bodily aesthetics in order to attain society's idealised male mesomorphic body type^{3,4,5,6,7}. The aim of this article is to provide an overview of anabolic steroids, including: 1) who uses them and why; 2) how the drugs are used; 3) the prevalence of use in the UK; 4) the risks to health; and, 5) basic harm reduction advice.

Who uses anabolic steroids and why?

As is the case with users of any substance, those using anabolic steroids are not a homogenous group. The vast majority of users are male, with female use limited to a small number of competitive bodybuilders and sportswomen^{4,5}. Whilst the reasons why people choose to use anabolic steroids are often complex and diverse it is possible to consider them

¹ Bhasin, S., Storer, T. W., Berman, N., Callegari, C., Clevenger, B., Phillips, J., Bunnell, T. J., Tricker, R., Shirazi, A., & Casaburi, R. (1996). The effects of supraphysiologic doses of testosterone on muscle size and strength in normal men. *New England Journal of Medicine*, 335 (1), 1–7.

² Fainaru-Wada, M., & Williams, L. (2007). *Game of Shadows*. New York, United States of America: Gotham Books.

³ Williamson, D. J. (1993). Anabolic steroid use among students at a British college of technology. *British Journal of Sports Medicine*, 27 (3), 200-201.

⁴ Korkia, P., & Stimson, G. V. (1993). Anabolic steroid use in Great Britain: an exploratory investigation. A report to the Department of Health, the Welsh Office and the Chief Scientist Office, Scottish Home and Health Department. London, United Kingdom: Her Majesty's Stationery Office.

⁵ Lenehan, P., McVeigh, J., & Bellis, M. A. (1996). A study of anabolic steroid use in the North West of England. *Journal of Performance Enhancing Drugs*, 1 (2), 57–70.

⁶ Dawson, R. T. (2001). Drugs in sport – the role of the physician. *Journal of Endocrinology*, 170 (1), 55–61.

⁷ Bolding, G., Sherr, L., & Elford, J. (2002). Use of anabolic steroids and associated health risks among gay men attending London gyms. *Addiction*, 97 (2), 195-203.

in three broad categories, although it is important to note that these are not mutually exclusive and the main reason for use may change overtime: 1) Professional athletes and sportspersons who use predominately in order to enhance their sporting performance. 2) Occupational users, such as those in the security industry (e.g. door supervisors and security guards), prison officers and police officers whose major reasons for use are to increase both body size and aggression in order to protect and intimidate others. There are also those in the entertainment industry, such as dancers and actors, who use to enhance their physique as required by their occupation. 3) Body image users whose primary aim is to increase muscle mass and, hence, body image satisfaction.

Research into what drives the desire for increased muscularity is still very much in its infancy, particularly in relation to the UK context. However, in the past few years a hypothesis has been advanced that attempts to explain the rise in steroid use for physique/aesthetic reasons. Here it is reasoned that structural factors such as an increased emphasis on, and visibility of, the 'body beautiful' (including the marketing of the male body) and the 'crisis in masculinity' (where females have, increasingly, achieved parity with their male counterparts, particularly within the realms of equality within the workplace and economic independence) are projecting the message that "real men have muscles"⁸⁹. When this message is internalised and coupled to other influences such as personal, parental and peer, it can serve not only to induce body dissatisfaction, but also powerfully reinforce this socially sanctioned body type as both desirable and obtainable. Ultimately this drive for muscularity can act as a catalyst for change, and within such a framework some individuals resort to steroid use as a means to attaining and maintaining this ideal.

When interacting within a health setting with steroid users or those contemplating use it is helpful to be aware of the motivations for use, as this will ultimately impact on the intervention provided. A seventeen-year-old male who wishes to look good on the beach and is contemplating using anabolic steroids may be receptive to discussions relating to improved training and nutrition in order to attain his goals. However, for the competitive bodybuilder with ten years experience of anabolic steroid use, safer injecting advice and health monitoring may well be more appropriate and acceptable.

How are anabolic steroids used?

Anabolic steroids are commonly used in self-directed, high dose, polydrug regimens based on a function of availability, cost, personal goal, self-experimentation and local culture. The latter two tend to be based on a diverse range of information sources that include other steroid users in the gym, steroid handbooks, magazines, and the internet.

Whilst there is considerable interpersonal heterogeneity in these regimens, there are three central tenets practised by the majority of users; cycling, stacking and the use of ancillary drugs⁶.

⁸ Grey, J. J., & Ginsberg, R. L. (2007). Muscle dissatisfaction: An overview of psychological and cultural research and theory. In K. Thompson & G. Cafri, (Eds.), *The muscular ideal: psychological, social, and medical perspectives* (pp. 15–39). Washington DC, United States of America: American Psychological Association.

⁹ Grogan S. (2008). *Body image: understanding body dissatisfaction in men, women and children* (2nd ed.). Hove, United Kingdom: Routledge. pp. 81–107.

Cycling is where anabolic steroids are taken for a number of weeks ('on cycle' which is typically 6–12 weeks), followed by a period of drug-free training ('off cycle'). Users' rationale for this cyclical practice is to prevent tolerance to the steroids and to limit the potential for side effects.

Alongside cycling, users will also usually take two or more anabolic steroids concomitantly in a practice known as stacking. The rationale here is that, given the different pharmacological profiles exhibited by steroids, taking multiple types will have specific, additional or synergistic effects. For example, whilst Sustanon ('Sus', which is a mixture of 4 different testosterone esters each with a different half-life) may be used as a "muscle & strength builder"¹⁰, nandrolone decanoate ('Deca') may also be used within the stack in order to "support [the] joints"^{10, 11}. However, this practice has not been empirically evaluated. The dosage for each of the specific drugs are typically many times higher than therapeutic levels. For example, a common stack includes Sustanon (500 mg/week), nandrolone decanoate (400 mg/week) and methandrostenolone (Dianabol) (140 mg/week)¹⁰.^{Finally}, users will often draw from a diverse pharmacopoeia of ancillary drugs that include other performance-enhancing drugs, drugs taken as both prophylactics to and for the treatment of steroid-induced side effects, and the use of recreational drugs that may also serve to enhance performance or as relaxants. Indeed, in regards to the latter, data from a sample of users from Merseyside found the prevalence of cocaine use to be substantially higher amongst steroid users than that in the general population¹².

Finally, users will often draw from a diverse pharmacopoeia of ancillary drugs that include other performance-enhancing drugs, drugs taken as both prophylactics to, and, for the treatment of, steroid-induced side effects, and the use of recreational drugs that may also serve to enhance performance or as relaxants (Table 1). Indeed, in regards to the latter, data from a sample of users from Merseyside found the prevalence of cocaine use to be substantially higher than that in the general population¹².

¹⁰ Evans-Brown, M. J., Beynon, C. M., McVeigh, J. (2008). Health needs of anabolic steroid users. Unpublished data.

¹¹ Monaghan, L. F. (2001). *Bodybuilding, drugs and risk*. London, United Kingdom: Routledge. pp. 105.

¹² McVeigh, J. (2008). *Anabolic steroids and associated drugs: Public health implications and harm reduction*. 19th International Conference on the Reduction of Drug Related Harm, Barcelona, Spain.

Table 1. Common ancillary drugs

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Drug	Trade/other names	Rationale for use
Human Growth Hormone (HGH)	Somatropin [®]	HGH (injectable) is used as an anabolic agent and, increasingly, as a 'fat stripper'.
Ephedrine		Ephedrine (oral) is used as both an anabolic agent and 'fat stripper'.
Clenbuterol	Spiropent [®] , Ventolase [®]	Clenbuterol (oral) is a β_2 agonist and used as both an anabolic agent and 'fat stripper', and is seen as having a relatively low potential for side effects.
Insulin	Actrapid [®] , Monotard [®] , Humulin [®]	Insulin (injectable) is used as an anabolic agent.
Insulin-like Growth Factor-1 (IGF-1)	Mecasermin, Increlex [®]	IGF-1 (injectable) is used as an anabolic agent.
Diuretics	Furosemide, Spironolactone	Diuretics (oral and injectable) are used for a variety of reasons, including: treating water retention caused by certain types of steroids; enhance muscular definition; and, in competitive sport, to drop a weight category.
GHB (γ -hydroxybutyrate)	Liquid E, Liquid X, GBH	GHB (oral) can induce a hypnotic sleep state and it was thought that this might promote the release of endogenous growth hormone, and, thus, act as an indirect anabolic agent. There have been a number of reports of individuals who have become addicted to the substance as a result of its use.
Tamoxifen	Nolvadex [®]	Tamoxifen (oral) is used to block the effects of estrogen. There is widespread prophylactic use of tamoxifen amongst steroid users, (and, anecdotally, an increasing use of aromatase inhibitors) to prevent gynaecomastia.
Human Chorionic Gonadotrophin (HCG)	Pregnyl [®]	HCG (injected) is taken to 'kick start' the endogenous production of testosterone when stopping use (as production is often shutdown due to high-levels of exogenous steroids).
Nalbuphine hydrochloride	Nubain [®]	Nalbuphine (injectable) was originally used as an anti-catabolic agent. However, use has shifted to the management of pain from training injuries and overexertion. There have been a number of reports of individuals who have become addicted to the substance as a result of its use.
Cocaine	Coke	Recreational drug/Used to enhance training (snorted)
Ecstasy	E	Recreational drug (oral)
Cannabis	Marijuana, grass, skunk, weed, spliff	Recreational drug/Used as a relaxant (smoked/oral)
Amphetamine	Speed, whizz, uppers, billy	Recreational drug/Used to enhance training (oral and injectable)

How many people use anabolic steroids in the UK?

There is a lack of data on the prevalence of anabolic steroid use in the United Kingdom, primarily because of the low priority this form of drug use has within policy. Indeed, the sole mention of this issue within the National Drug Strategy is within the context of "those who tarnish our national image by cheating in sport"¹³.

Prevalence studies have for the most part been limited to local surveys^{3,5} with the only national study completed some 18 years ago which found that from 1,667 participants drawn

¹³ HM Government. (2008) Drugs: protecting families and communities. The 2008 drug strategy. London, United Kingdom: HM Government.

from 21 gyms from across England, Wales and Scotland, 6% of men and 1.4% of women were current users of anabolic steroids⁷. The British Crime Survey, the mainstay of drug use estimates used to inform government drug policy, has recently reported a reduction in steroid prevalence between 1998–2008, with lifetime use estimated to be 200,000¹⁴. However, needle and syringe programmes (NEPs) across the UK tell a different story. In Merseyside and Cheshire the number of new steroid-injecting clients attending agency-based NEPs between 1991 and 2006 increased seven-fold, whilst overall during this period there was a 2000% increase in the number of steroid injectors attending exchanges¹⁵. For the past three years, new clients injecting steroids have outnumbered new injectors of all other drugs combined. Furthermore, analysis of injecting equipment transaction data and interviews with the clients themselves indicate a high level of peer distribution of injecting equipment, which suggests that anabolic steroid users attending these services may be only the “tip of the iceberg”¹⁶. Whilst comparative data are unavailable for most areas of the country, anecdotal reports from SEPs across the UK suggest that this is not a localised phenomenon. To what extent these data reflect an increase in use or merely an increased uptake of syringe exchange services is unknown, however it does provide an indication of the extent of use of these drugs.

The risks to health

The use of anabolic steroids has been associated temporally with a diverse number of adverse effects on both physical and psychological health which, on occasion, have been fatal¹⁷. However, this area remains under researched, with the evidence base over reliant on data from self-reported side effects and case reports. Indeed, the conclusions that may be drawn from the body of evidence, especially in relation to the more serious effects, are limited by methodological issues such as the failure to recognise: 1) the compound-specific effects of anabolic steroids (and, hence, the degree to which they diverge from the effects mediated by testosterone); 2) the heterogeneous nature and practices of this group, especially in relation to polydrug regimens (drugs used, dose taken, duration of use); and, 3) the lack of longitudinal studies within this population. Points 1 and 2 are a major determinant of the unique pharmacological environment that users will experience, and, in turn, a critical component in our understanding of the pathogenesis of both acute and chronic steroid-related health effects which may develop over time (point 3). Variables such as sex, age, lifestyle, and genetic factors also likely to significantly affect this process. Ultimately, the limitations in the evidence base have restricted the ability to quantify risks from a clinical perspective, and, therefore, provide unambiguous information on risks to users.

¹⁴ Hoare, J. & Flatley, J. (2008). *Drug Misuse Declared: Findings from the 2007/08 British Crime Survey England and Wales*. London: Home Office.

¹⁵ Evans-Brown, M. J. & McVeigh, J. (2008). An introduction to anabolic steroids. *Sport EX medicine*, 38 (Oct), 20–26.

¹⁶ McVeigh, J. (2008). Public health implications of anabolic steroid use. The 13th National Conference: Management of Drug Users in Primary Care. Brighton, United Kingdom.

¹⁷ Hartgens, F., & Kuipers, H. (2004). Effects of androgenic-anabolic steroids in athletes. *Sports Medicine*, 34 (8), 513–554.

Table 2. Adverse health effects associated with anabolic steroid use

(modified from ref. 15 with permission from Centor Publishing Ltd.).

Adverse effect	Notes
Acne	Large numbers of steroid users self-report acne.
Androgenetic alopecia (male pattern baldness)	In those who are genetically susceptible, the use of steroids appears to speed up the progression of scalp hair loss. Conversely, many steroid users report increased growth of body hair when using steroids.
Gynaecomastia	Gynaecomastia is the growth of the glandular breast tissue in males thought to be caused by an imbalance in the ratio of testosterone to oestrogen. This can be mediated through the increased peripheral aromatization of exogenous steroids to oestrogenic metabolites, and/or alterations in the transport/binding of both exogenous steroids, their oestrogenic metabolites and endogenous testosterone and oestrogen. Furthermore, many of the drugs commonly used by this population (such as growth hormone, human chorionic gonadotropin, spironolactone) have also been associated with gynaecomastia.
Genitourinary (men)	High levels of exogenous steroids can suppress endogenous testosterone production and spermatogenesis, leading to transient testicular atrophy. It can take many months for endogenous testosterone production and fertility to recover. Many users report increased libido during an "on" cycle. Conversely, during an "off" cycle libido is often suppressed (due to suppression of endogenous testosterone production). Users report erectile dysfunction both during "on" cycles and "off" cycles. There has been a case report of prostatic cancer in a long-term steroid user and a small number of case reports of renal cancers.
Liver	Use of steroids, in particular the oral 17 α -alkylated preparations, has been associated with hepatic dysfunction and damage. There have been a small number of case reports of benign liver tumors, peliosis hepatis (blood-filled sacs in the liver) and hepatocellular carcinoma.
Cardiovascular	Use of steroids has been associated with a range of both acute and chronic cardiovascular pathological events. These include: hypertension, altered lipid metabolism, altered haemostatic system, cardiac arrhythmias, myocardial infarction, stroke, thrombosis, sudden cardiac death and cardiac hypertrophy.
Musculoskeletal	There have been a number of case reports where damage to tendons/ligaments have occurred after steroid use. It is thought that this could be as a result of disproportionate growth of the muscle compared to the tendons/ligaments. There have also been case reports of rhabdomyolysis (breakdown of muscle).
Psychological	Steroid use has been associated with hypomania, mania, increased aggression, violence and depression. Whilst it is unclear whether anabolic steroids have the potential to be physically addictive, they can be psychologically addictive, as for many individuals the positive effects of steroid use (including: increased training capacity; strength; enhanced appearance; and, feelings of well being) act as a strong reinforcer to continue/recommence use. It is thought that this can be a particularly strong force during an "off" cycle or when ceasing use because of the low levels of endogenous testosterone.
Specific concerns for young people	Adolescence is a complex time of physical, emotional and psychological development which is mediated, in part, by the endogenous equivalents of commonly used performance- and image-enhancing drugs such as testosterone, growth hormone and insulin-like growth factor-1. The use of supraphysiological doses of these drugs during this time in development could, potentially, disrupt the normal pattern of growth and behavioural maturation.
Specific concerns for females	Given the low endogenous levels of testosterone in females, any increase through exogenous sources (i.e. anabolic steroids) can have a marked effect, and can lead to virilisation which includes: hirsutism, deepening of the voice, amenorrhoea/anovulation, clitoral enlargement, atrophy of breast tissue, and changes in libido. The impact of these effects can be pronounced and in some cases permanent.

Anecdotal data suggests that the majority of the anabolic steroids available in the UK are substandard, including a large number of counterfeit and fake products. This does not mean that they do not contain anabolic steroids, but they may not be the specific drug they purport to be^{18,19}, nor the strength specified on the packaging²⁰. Counter-intuitively, illicitly produced anabolic steroids may contain higher levels of active ingredients than legitimate products²⁰. As many of the associated adverse effects of anabolic steroids are dose related, this further complicates efforts to minimise the adverse effects of these substances. An additional concern regards the sterility of these drugs²¹. As the vast majority of anabolic steroid users inject^{4,5,7},

¹⁸ Musshoff, F., Daldrup, T., & Ritsch, M. (1997). Black market in anabolic steroids — analysis of illegally distributed products. *Journal of Forensic Sciences*, 42 (6), 1119–1125.

¹⁹ Thevis, M., Schrader, Y., Thomas, A., Sigmund, G., Geyer, H., & Schänzer, W. (2008). Analysis of confiscated black market drugs using chromatographic and mass spectrometric approaches. *Journal of Analytical Toxicology*, 32 (3), 232-240.

²⁰ Perry, H. (1995). Counterfeit-fake anabolic steroids and hazards of their use. *Relay*, 1 (4), 9-12.

²¹ Bergman, R. T. (1993). Contaminated drug supply. *The Physician and Sportsmedicine*, 21 (2), 8.

they are also at risk of bacterial infections at the site of injection²². For those who share injecting equipment (or re-use injecting equipment and, subsequently, share multi-dose vials with others), blood-borne viruses such as HIV, hepatitis B and hepatitis C are genuine risks²³²⁴²⁵. The issue of blood-borne virus transmission is compounded by the fact that the majority of users report increased libido as a result of steroid use^{4,5}, which could increase the potential for their transmission (and that of other sexually transmitted infections) if users engage in risky sexual behaviour.

Harm reduction

There is a paucity of robust evidence relating to the risks of adverse health effects as a result of steroid use. This is coupled to the fact that for many years the medico-scientific community repudiated the performance-enhancing effects of these drugs²⁶, and promulgated unsubstantiated views of the dangers of these drugs. No doubt this was done with the best of intentions, but such views have not been matched by steroid users “dropping like flies”²⁷. These factors have limited the trust and credibility that many steroid users place in health professionals⁴. Compounding this lack of trust is the demonisation of steroids and users by the media and wider society, as well as the fact that government policy has been directed predominately by anti-doping efforts within elite sport¹³. This has left the majority of steroid users marginalized and apart from the provision of sterile injecting equipment (predominately through syringe exchange services), limited opportunities have been developed for this population to engage with health professionals to reduce harm and promote health. Ultimately, as a result, users have had to rely on ‘locker-room anecdotes’⁶ (both within gyms, and, increasingly, through the internet).

It does appear, however, that there are a significant number of users who would welcome engagement with health services^{4,6}— in a context-sensitive, non-judgemental manner that meets their needs. This will require that we firstly explore new ways of engaging with this population, which should start with listening to them, and providing them with an environment where they can articulate, prioritise and reflect on their concerns and needs. Additionally it requires that health professionals have the relevant skills and knowledge in place, in order to work with steroid users. Correspondingly this requires that we further develop the evidence base on both the positive and negative effects of steroid use. Indeed, in response to local need, some specialist services have been developed in the UK. For example, the Drugs In Sport Clinic and Users’ Support (DISCUS) in Tyne & Wear provide medical, dietary and harm reduction services. However, these services are the exception rather than the rule.

²² Perry, H. (1995). Counterfeit-fake anabolic steroids and hazards of their use. *Relay*, 1 (4), 9-12.

²³ Dickinson, B. P., Mylonakis, E., Strong, L. L., & Rich, J. D. (1999). Potential infections related to anabolic steroid injection in young adolescents. *Pediatrics*, 1999, 103 (3), 694.

²⁴ Rich, J. D., Dickinson, B. P., Merriman, N. A., & Flanigan, T. P. (1998). Hepatitis C virus infection related to anabolic-androgenic steroid injection in a recreational weight lifter. *The American Journal of Gastroenterology*, 93 (9), 1598.

²⁵ Health Protection Agency, Health Protection Scotland, National Public Health Service for Wales, CDSC Northern Ireland, and the CRDHB. (2008). *Shooting Up: Infections among injecting drug users in the United Kingdom 2007*. London: Health Protection Agency.

²⁶ Taylor, W. (1991). *Macho Medicine. A history of the steroid epidemic*. London, United Kingdom: McFarland & Company. pp. 24–33.

²⁷ Yesalis, C. E., Wright, J. E., & Bahrke, M. (1989). Epidemiological and policy issues in the measurement of the long term health effects of anabolic-androgenic steroids. *Sports Medicine*, 8 (3), 129–138.

Until such services become more widely available as a minimum there should be provision of sterile injecting equipment and basic harm reduction advice universally available in a format appropriate for steroid users.

Key points for practitioners

- **Recognise the potential for steroid use in patients — particularly those who present with mesomorphic or hypermesomorphic body types.**
- **Always approach the issue in a non-judgemental way and listen to the patient's concerns.**
- **Recognise that there are diverse drivers of steroid use and look at motivations for use — can their goal be achieved without steroids?**
- **If an individual is intent on using steroids, then basic harm reduction advice should be given.**

Harm reduction advice for steroid users

- **Always use sterile injecting equipment. Never share.**
- **Use the smallest dose of steroids (do not adopt other users' regimes).**
- **Limit the length of "on cycles".**
- **Be aware of counterfeit drugs.**
- **Know how to inject safely.**
- **Spend adequate time on training, nutrition and sleep.**
- **Know the dangers of recreational drug use.**
- **Be aware of side effects. At the first sign of them, discontinue use and seek medical advice.**
- **If you need to take drugs to treat the side effects of your steroid use, it means your dose of steroids is too high.**
- **Inform your GP (and any other health practitioner) of your anabolic steroid use and take advantage of any health monitoring that is available.**
- **Just because you have read something about steroid use on the internet or from a magazine (or heard it from another user) doesn't necessarily mean it's true!**

In the United Kingdom, anabolic steroids (along with the related drugs clenbuterol, growth hormone and chorionic gonadotrophin) are controlled as Class C drugs under Schedule 4, Part II of the Misuse of Drugs Act 1971. Possession for personal use is legal if in the form of a medicinal product (including import and export). However, supply (including giving or sharing), intent to supply and production are illegal and punishable with up to 14 years imprisonment and/or an unlimited fine.

Developed at the Centre for Public Health, Liverpool John Moores University, [s.teroids.net](http://www.s.teroids.net) is an online discussion forum that facilitates the sharing of research, good practice and information around anabolic steroids (and ancillary drugs). It supports the dissemination of academic research results in a form that is both accessible and practical for health professionals engaging with users. www.s.teroids.net

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