



# Anabolic Steroid Abuse and Violence

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## INTRODUCTION

Violence is an issue of major public concern in Australia. Newspaper stories have implicated anabolic androgenic steroids in some physical assaults and fatalities. In the cases of Greg Wane and Steven De Souza, both found guilty of murder, the defendants used the defence of diminished responsibility due to anabolic androgenic steroid use (Betti 1995). The diminished responsibility defence due to 'roid rages' has been termed the 'dumbbell defence' or 'steroid defence' and has been used in legal cases in the United States (US) since 1988. 'Roid rage' is a term used by those in the weight training culture to refer to an anabolic androgenic steroid-related act of aggression.

This bulletin examines the relationship between anabolic androgenic steroid use and violence. There are four sections to the bulletin. The first two sections are concerned with the nature of anabolic androgenic steroids and their prevalence in Australia. The third section examines how anabolic androgenic steroids are obtained and used. In the final section, the physical and psychological harms associated with anabolic androgenic steroid abuse are discussed, with particular attention paid to evidence on the relationship between anabolic androgenic steroid use and increased aggression and violence.

For the purpose of this bulletin:

- the term 'anabolic' refers to the tissue-building effects (increasing muscle mass) of the steroid,
- the term 'androgenic' relates to the masculinising effect of the steroid,
- the term 'anabolic steroids' will be used instead of the proper name anabolic androgenic steroids, and

- 'anabolic steroid abuse' is defined as an illicit use of anabolic steroids and any use likely to cause damage or risk to the user or others.

## NATURE AND MEDICAL USE OF ANABOLIC STEROIDS

Anabolic steroids are synthetic derivatives of the testosterone hormone. Naturally occurring testosterone hormone is broken down rapidly by the liver when it is ingested or injected, giving little androgenic or anabolic benefit to the recipient. By artificially altering the structure of testosterone this problem has been overcome (Yesalis & Bahrke 1995). There are many variations of anabolic steroids, with some having greater androgenic effects and others greater anabolic effects. Anabolic steroids are primarily available in both oral and injectable form, however transdermal patches, buccal tablets (absorbed through the mouth) and nasal sprays have also been used as methods of anabolic steroid delivery (Yesalis & Bahrke 1995). The oral form of anabolic steroids is modified to slow down its use in the liver. The injectable form is generally fat-soluble, resulting in a slow release into circulation and therefore a prolonged action (Wilson 1988). Modifications of the testosterone structure can also enhance the potency of a given anabolic steroid or alter its metabolism, in addition to slowing the rate of inactivation in the liver (Hoberman & Yesalis 1995).

## MEDICAL USE OF ANABOLIC STEROIDS

Anabolic steroids are restricted substances in Australia. They can be

legally obtained from medical practitioners for a limited number of purposes, such as to treat muscle wasting. Historically, anabolic steroids have been used to treat medical conditions such as reproductive dysfunctions, anaemia, metastatic breast cancer and protein deficiency (Kochakian 1993). Anabolic steroids have also been used to treat depression, melancholia, and involuntal psychoses (Bahrke, Yesalis & Wright 1990).

Currently, anabolic steroids are being used to help treat trauma patients (burns, surgery, radiation therapy) and patients with chronic debilitating illnesses that result in muscle wasting such as HIV. Additionally, they are used to treat male and female hormonal dysfunctions, as well as being used in replacement therapy for men with hypogonadism, treatment of impotence and to stimulate growth and initiate puberty in boys. In the United Kingdom (UK), anabolic steroids are being used as hormone replacement therapy for men over 54 years. It is claimed that testosterone therapy for men can prevent physical ailments and depression, strengthen ageing bodies and restore a waning interest in sex (Hoberman & Yesalis 1995). The World Health Organisation has completed successful trials using anabolic steroids as a male contraceptive. It should be noted that in those trials, anabolic steroids proved to be an effective contraceptive for men, with minimal short-term side effects (WHO Task Force on Methods for the Regulation of Male Fertility 1990).

## ANABOLIC STEROIDS AND MUSCLE STRENGTH

There is general agreement that anabolic steroids do not enhance the

aerobic capacity of athletes (Elashoff et al. 1991; Yesalis, Wright & Lombardo 1989). In terms of increased muscle size and strength, there have been equivocal findings. This is due in part to early studies which had poor methodological designs, such as failing to control for diet, level of weight training experience, training programs, specificity of testing, small sample sizes, and low-dose regimes (Celotti & Negri Cesi 1992; Yesalis, Wright & Lombardo 1989).

It has been proposed that anabolic steroids may increase strength and muscle bulk by reducing protein breakdown during training, increasing fluid and electrolyte retention, inducing a faster recovery after strenuous exercise, and producing psychological effects (increasing aggressiveness, euphoria and diminished fatigue) which might facilitate training and help in competitive performance (Celotti & Negri Cesi 1992). Bhasin et al. (1996) in a double blind study found that weekly doses of 600mg of testosterone enanthate (a type of anabolic steroid), when combined with strength training, significantly increased muscle mass and strength in normal men.<sup>3</sup> The weekly doses of 600mg were six times greater than the doses usually given to men to treat hypogonadism, and are the highest administered for any study of athletic performance. After 10 weeks, subjects in the experimental group averaged an increase of 6.1 kg of fat free muscle mass.

Some researchers, such as Kennedy (1992), suggest that, in some instances, increases in strength are possibly related to placebo effects (i.e. effects which occur as a result of a subject's expectations rather than effects due to the action or effect of the drug) motivating improved training. Generally, strength and size have been shown to increase when subjects train intensively and maintain a high-protein, high-calorie diet (Celotti & Negri Cesi 1992; Lamb 1984). Most clinical trials are limited as they involve low to moderate doses of anabolic steroids, and cannot be generalised to anabolic steroid users who are taking very high doses (up to 10 times recommended pharmacological dose), often involving several different anabolic steroids (Elashoff et al. 1991).

## PREVALENCE OF ANABOLIC STEROIDS

It is difficult to accurately gauge the exact

number of people in Australia using anabolic steroids for non-medical purposes. In the 1993 Australian National Drug Strategy household survey, three per cent of respondents (persons aged 14 years or over) reported anabolic steroid use at some stage in their lives (i.e. 444,000 Australian people aged 14 years or over), with the extent of use ranging from 2.1 per cent in the Australian Capital Territory to 5.4 per cent in Western Australia (Department of Health, Housing and Community Services 1993). Ninety per cent of those who admitted anabolic steroid use claimed to have taken the drugs for medical purposes, although the definition of such use was not made clear. However, many people who use anabolic steroids for increasing muscle mass and strength obtain their steroids from medical practitioners (Beel 1996a; Mugford 1995; Plowright 1993; Senate Standing Committee on Environment, Recreation and the Arts 1989) and it is possible that these types of users regard their use as 'for medical purposes'. The remaining 10 per cent reported using anabolic steroids for non-medical purposes. This provides an Australian population estimate of 44,000 people aged 14 years or over who have used anabolic steroids for non-medical purposes at some time in their lives (Department of Health, Housing and Community Services 1993).

Estimates of use from the 1993 and 1995 Australian National Drug Strategy household surveys suggest that the proportion of people who are using steroids for non-medical purposes has remained fairly stable in recent years. In the 1993 survey, 0.1 per cent of people reported using steroids for non-medical purposes in the last 12 months, while the comparable proportion in the 1995 survey was 0.2 per cent (i.e. 28,000 people aged 14 years or over; Drugs of Dependence Branch 1996). The available evidence suggests that the US has higher usage rates than Australia. In a US survey, 0.5 per cent of respondents admitted they had used in the past year (0.9 per cent males and 0.1 per cent females, 12 years or over; Yesalis et al. 1993).

## USAGE AMONG COMPETITIVE ATHLETES IN AUSTRALIA

Anabolic steroids are one of a variety of performance-enhancing substances tested for by the International Olympic Committee. Australian athletes test positive for performance-enhancing

drugs less often than other Olympic Athletes (1 to 2 per cent compared with 2.5 per cent). Furthermore, of the athletes who test positive for performance-enhancing drugs, a smaller proportion of Australians test positive for anabolic steroids than other athletes (Klarica 1995; Beckett 1991).

While the comparative rate for positive drug tests is low amongst competitive athletes, there is evidence that these figures may not present the full picture. It has been reported in the US that when testing is announced, only two per cent of athletes test positive for performance-enhancing substances, whereas when testing is unannounced (generally out of competition) 50 per cent test positive (Dubin 1990). Drug use has also been identified across a wide variety of sports in Australia at sub-elite levels, and in particular in weight training (Senate Standing Committee on Environment, Recreation and the Arts 1989).

## USAGE AMONG WEIGHT TRAINERS

In a 1980s Australian survey of 72 weightlifters, 15.7 per cent reported using anabolic steroids, and almost 24 per cent said they intended to use steroids in the future (Haynes 1982). According to the survey, anabolic steroid use was highest among powerlifters (22.4 per cent reported using steroids). In a more recent survey of 197 weight trainers recruited from Australian gymnasiums and a bodybuilding association, 16.2 per cent of respondents admitted using anabolic steroids (18.2 per cent of the males and 9.3 per cent of the females) (Chee et al. 1994). These figures could overestimate the prevalence as they were obtained from a high risk/use group (i.e. bodybuilders).

Reports from international gym studies vary widely, and may reflect differences in the clientele attending these gyms. In studies of 'hard-core' gyms, which attract powerlifters and those seriously committed to bodybuilding, usage rates of 30 to 40 per cent have been reported (Gridley & Hanrahan 1994; Perry, Wright & Littlepage 1992; Tricker, O'Neill & Cook 1989). Studies involving gyms with a wider cross-section of weight trainers have reported lower rates of anabolic steroid use. Korkia and Stimson (1993), who investigated anabolic steroid use amongst weight trainers in 21 gyms throughout the UK, found that 7.7 per cent of gym participants had used them at some time, with five per cent currently using. Usage rates varied across the 21 gyms surveyed from zero to 46 per cent

of respondents.

### USAGE AND INTENTION TO USE AMONG HIGH SCHOOL STUDENTS

Australian high school surveys of self-reported anabolic steroid use report rates ranging from 1.2 to 3.2 per cent for males and 0.2 to 2.0 per cent for females (Mugford 1995; Department of Health, Housing and Community Services 1993; Henderson, Kelley & Sheehan 1990). In a survey of four private schools in New South Wales, 33 per cent of males aged 16 to 18 years (n=220) and 10 per cent of females aged 16 to 18 years (n=218) indicated they were considering future anabolic steroid use (McGufficke, Rowling & Bailey 1990).

In Canada it has been found that about three per cent of students aged 11 to 18 years have used anabolic steroids (4.1 per cent of males and 1.5 per cent of females; Canadian Centre for Drug-Free Sport 1993). For the male students, this use was found to increase with age. The use by males increased from three per cent amongst 13 and 14 year olds to five per cent amongst 15 to 17 year olds, to seven per cent amongst males aged 18 years or over. For female students the usage rate varied between one and two per cent. In the US, the level of use among boys appears to be comparable to that of Canada, with one study reporting that 6.6 per cent of males in the 12th grade (aged 17 to 18 years) have used anabolic steroids (Buckley et al. 1988).

### AGE OF USERS

Australian and overseas evidence indicates that steroid users are predominantly young (Gridley & Hanrahan 1994; Department of Health, Housing and Community Services 1993; Korkia & Stimson 1993; Plowright 1993; Yesalis et al. 1993; Brower et al. 1991; Taylor & Black 1987). The 1993 Australian National Drug Strategy household survey found that the majority of male users were aged 25 to 34 years and female users aged 20 to 24 years (Department of Health, Housing and Community Services 1993). Most users (75 per cent) had tried anabolic steroids by the time they were 17 years old.

### OBTAINING AND USING ANABOLIC STEROIDS

Anabolic steroids are easy to obtain in Australia (Beel 1996a; Mugford 1995; Australian Customs Service 1992; Senate Standing Committee on Environment, Recreation and the Arts 1989) and overseas (Korkia & Stimson 1993), and for most users the black market is the main source. Black market anabolic steroids include counterfeit, veterinary, illegally imported and any other source of anabolic steroids other than medically prescribed (Luetkemeier et al. 1995; Kersey 1993; Korkia & Stimson 1993). From the 1988 Australian Parliamentary inquiry into drugs in sport, it was estimated that the total market in anabolic steroids in Australia was worth between \$15 million and \$150 million, most of which involves the black market (Senate Standing Committee on the Environment, Recreation and the Arts 1989). The extreme variation in estimates exemplifies how little is known about the black market and anabolic steroid consumption.

Anabolic steroids are usually obtained from a friend or friendly acquaintance (Beel 1996a; Mugford 1995; Kersey 1993; Korkia & Stimson 1993; Plowright 1993). This friendly source may vary and can include pharmacists, coach/trainers, relatives, gym personnel, veterinarians and dealers.

Currently, Australian classifications and sanctions vary from State to State. Veterinary steroids are used by approximately 10 per cent of users in both New South Wales and Western Australia (Beel 1996a). It has been reported that these steroids are more attractive than other black market anabolic steroids and prescribed anabolic steroids because they are cheaper and the legal penalties for possession tend to be less severe (Senate Standing Committee on Environment, Recreation and the Arts 1989). In fact, some veterinary anabolic steroid preparations can be bought over the counter at agricultural supply stores. This is of concern, given that veterinary anabolic steroids have not been manufactured and tested for human consumption.

While the black market remains the major source of anabolic steroids, many users get their drugs legally from doctors. In Australia, between five and 51 per cent of anabolic steroid users obtain their anabolic steroids from a medical practitioner (Beel 1996a; Mugford 1995; Plowright 1993; Senate Standing Committee on Environment, Recreation

and the Arts 1989). In the US, between four and 33 per cent of high school students, and two to 20 per cent of gym-based weight trainers using anabolic steroids, obtain them on medical prescription (Luetkemeier et al. 1995; Kersey 1993; Korkia & Stimson 1993; Komoroski & Rickert 1992; Kusserow 1990; Terney & McLain 1990). Some evidence from the US indicates that more sophisticated users, for example bodybuilders and powerlifters, are more likely than other weight trainers to obtain anabolic steroids from a medical professional, with between 18 and 41 per cent doing so (Haislip 1993; Van Raalte, Cusimano & Brewer 1993; Yesalis et al. 1988). A study of technical college students in the UK found that 17 per cent of users obtained their anabolic steroids from a medical professional (either a physician or pharmacist) (Williamson 1994).

### METHODS OF USE

Anabolic steroids are generally administered by either oral tablet or injection. The doses are typically pyramided (low dose to high dose then tapering back to no use), and the user may take several anabolic steroids at a time (stacking). The user has to cycle on and off the drugs (typically six to 12 weeks on then six to 12 weeks off) to get continued effect. Approximately 75 per cent of Australian anabolic steroid users have used injectable forms of anabolic steroids (Beel 1996a; Chee et al. 1994). Needle exchange operations report that anabolic steroid users represent between 25 and 40 per cent of their caseload (Shapiro 1992). In Australia there is virtually no self-reported sharing of needles. This has been attributed to the anabolic steroid user's concern for health, the availability of injecting equipment and the needle education programs associated with the National AIDS campaign (Plowright 1993).

Internationally, there has been greater reporting of needle sharing and two recorded cases of HIV transmission (in two bodybuilders) through needle sharing (Scott & Scott 1989; Sklarek et al. 1984). In their study of UK weight trainers, Korkia and Stimson (1993) found that 5.6 per cent of the current injectors admitted that they had shared a needle or syringe. A Welsh study found 4.2 per cent had shared in the past, although 12.8 per cent of injecting users reported that they had lent their equipment to other users (Perry, Wright & Littlepage 1992).



Studies of US and Canadian high school students report widely varying needle sharing rates (Canadian Centre for Drug-Free Sport 1993; DuRant et al. 1993; Adlaf & Smart 1992).

Despite the low reported incidence of needle sharing, the potential exists for the transmission of HIV and other blood borne viral infections amongst anabolic steroid users. It is possible that needle sharing behaviour is under-reported amongst injecting anabolic steroid users because of the stigma attached to admitting such behaviour.

## ADVERSE CONSEQUENCES OF ANABOLIC STEROID USE AND ABUSE

As indicated in the introduction, anabolic steroid abuse is defined as any illicit use of anabolic steroids and any use likely to cause damage or risk to the user or others. The abuse of anabolic steroids can have adverse physical, psychological and social consequences.

### PHYSICAL SIDE EFFECTS

The physical side effects experienced when taking anabolic steroids depend on the specific drug taken, the size and frequency of doses, duration of use, route of administration, and the age, health, and any predisposing variables unique to the user. Given the high rates of use and dosages consumed (up to 10 times greater than the recommended medical doses), the levels of reported adverse side effects and fatal side effects are low (Yesalis & Bahrke 1995; Wilson 1988). However, reported physical adverse consequences associated with anabolic steroid use in males include gynecomastia (i.e. enlargement of the breasts), transient infertility and testicular atrophy. Females report decreased breast size and menstrual irregularities. Problems for both sexes include skin rashes, acne, growth of facial hair, deepening of the voice, oedema (i.e. water retention), jaundice, changes in libido and increases in appetite and aggressiveness (Friedl 1990; Johnson 1990). Additionally there have been reported cases of ruptured tendons as a result of anabolic steroid use (Liow & Tavares 1995).

Occasional chronic side effects include liver disease, cardiovascular disease and sterility (Friedl 1990; Johnson 1990). In

Australia, at least one case of cerebral haemorrhage (Moss-Newport 1993) and two cases of fatal heart attack (Kennedy & Lawrence 1993) have been recorded. Use has also been linked to cardiac hypertrophy (i.e. increase in heart size; Nieminen et al. 1996) and increased serum lipoprotein levels (i.e. high blood fat levels), fluid retention and hypertension as well as blood clotting abnormalities (Taylor & Black 1987; Hurley et al. 1984).

Although there is potential for serious long-term health problems, there is some evidence that the vast majority of users do not experience such problems (Silvester 1995). A longitudinal Australian study of 169 'casual athletes' (i.e. athletes not in serious elite competition, such as casual weight trainers and sports players) who were prescribed low to moderate doses of anabolic steroids found that side effects were minimal and reversible (Millar 1994). Further, the World Health Organisation in a one-year trial of an anabolic steroid (testosterone enanthate) as a male contraceptive found no irreversible adverse side effects (WHO Task Force on Methods for the Regulation of Male Fertility 1990). However, it is still not clear what the pattern of physical harm may be in the longer term, especially in those who have been chronic users, or who have consumed doses well in excess of prescribed levels.

### PSYCHOLOGICAL EFFECTS

#### Research difficulties

It is difficult to establish the psychological effects of anabolic steroids, particularly among the groups of users that have been discussed in this bulletin (weightlifters etc.). Users often take non-medically prescribed steroids, such as veterinary steroids and counterfeit steroids, and they may be taking very high doses and/or several drugs at the one time. Research that has been conducted has often been methodologically flawed and has produced results which may not generalise to the anabolic steroid user population. Problems include not controlling for multiple drug use, poor definition of what constitutes aggressive behaviour, not collecting baseline measures of aggression, using measures of aggression that do not transfer to the real world, not validating the drugs

reported being used, not using control groups, inappropriate sampling, self-reporting and not distinguishing between classes of anabolic steroids (Kouri et al. 1995; Yesalis & Bahrke 1995; Bahrke, Yesalis & Wright 1990; Pope & Katz 1988; Ehrenkranz, Bliss & Sheard 1974). Further, it has been found that even when researchers have attempted to control for some of these factors, it has been very difficult to establish the exact doses involved or the identity of the anabolic steroids used (Freenchick 1996).

Despite these shortcomings, some evidence has accumulated which suggests that the abuse of anabolic steroids can lead to a number of problems, including depression, mania, hypomania, increased hostility, increased aggression, dependency and suicide attempts. Two types of psychological effects are discussed below: mood disorders and aggression.

#### Mood disorders

In a study of 88 anabolic steroid-using athletes, Pope and Katz (1994) found a significant relationship between the level of anabolic steroid use and mood disorders. Twenty-three per cent of the subjects displayed affective disorders including mania, hypomania and major depression. These disorders were most likely to occur when the athlete was taking the drug. In previous work by Pope and Katz (1990), 22 per cent of bodybuilders and footballers were found to meet the American Psychiatric Association's criteria for a manic or depressive episode. These subjects reported remission of symptoms within a few weeks of stopping anabolic steroid use. Pope and Katz (1988) concluded that there may be a relationship between the consumption of high doses of anabolic steroids and the development of mood disorders. Williamson (1994, p.20) in a summary of five case study reports of individuals developing mental illness ranging from schizophrenia-like illness, paranoia, depression, anxiety and mood swings, concluded that 'anabolic steroids could precipitate a psychiatric illness in certain predisposed individuals'.

However, not all studies have found a link between anabolic steroid use and mood disorders. Research by Perry, Yates and Andersen (1990) and Bahrke et al. (1992) found no differences between anabolic steroid users and non-users on major mental disorders or mood disturbance, although in the latter study, the users complained more often of experiencing depression, anxiety and

hostility than the non-users. The authors suggested that the instruments used may not have been sensitive enough to detect differences (Bahrke et al. 1992).

### Aggression and violence

The issue of anabolic steroid use leading to aggression and violence is of particular concern to the community. Male and female athletes often report increases in aggression and irritability as a result of anabolic steroid use (Silvester 1995; Kennedy & Lawrence 1993; Korkia & Stimson 1993; Yesalis et al. 1993; Bahrke et al. 1992; Brower et al. 1991; Perry, Yates & Andersen 1990; Tricker, O'Neill & Cook 1989; Pope & Katz 1988; Strauss, Liggett & Lanese 1985). The term 'roid rage' is used by anabolic steroid users to describe acts of aggression that are often over 'little things' (Beel 1996b).

Choi and Pope (1994), in a study of 24 anabolic steroid users and 14 non-users, reported that anabolic steroid users, while on a drug use cycle, were more likely to report verbal and physical fights with their significant other compared with non-users and those not currently using. This finding supports previous research by Choi, Parrot and Cowan (1990) which found that strength athletes (including football players, weight trainers and field athletes) were more aggressive while on an anabolic steroid cycle. Case study reports have also linked anabolic steroid use, aggressive behaviour and violent crimes (Schulte, Hall & Boyer 1993; Dalby 1992; Conacher & Workman 1989). Pope and Katz (1990) reviewed three case studies, two involving homicide and one of attempted homicide committed by men using anabolic steroids who had shown no evidence of predisposing factors that would lead to violence. They concluded that 'anabolic steroids played a necessary, if not primary, role in the etiology of the violent behaviour' (Pope & Katz 1990, p. 28).

Kouri et al. (1995) have investigated the influence of increasing doses of an anabolic steroid (testosterone cypionate). In their study, subjects were randomly assigned to two treatment sequences involving combinations of either placebo injections, anabolic steroid injections or no treatment. Neither the researchers nor the subjects knew when they were receiving either the placebo or anabolic steroid injections. The researchers measured aggressive responses by using a game which involved pressing a

button to accumulate points (non-aggressive response) or another button to subtract points from a fictitious opponent (aggressive response). Though the measure of aggression may have limited 'real world' application, the results indicated that those on the anabolic steroid had significantly higher aggressive responses. Further, the study found that there was a provocation-response relationship. That is, subjects on the anabolic steroid were more likely to respond aggressively to a provocation from the fictitious opponent. This finding is supported by other studies (e.g. Beel 1996a; Parrot, Choi & Davies 1994).

Beel (1996a) surveyed 21 anabolic steroid users aged between 16 and 34 years and compared their characteristics to a general population sample (n=750). She found that anabolic steroid users were no different from the community comparison group in terms of education, income, height or alcohol consumption patterns. They were, however, more likely to report that roid rages were their response to small amounts of provocation.

A number of studies have failed to find any link between anabolic steroid use and increased aggression. Bjorkqvist et al. (1994) placed 27 males into either a testosterone administration, a placebo or no treatment group (control group). The placebo group was found to have higher scores than the testosterone or control groups for self-estimated anger, irritation, impulsivity and frustration. The authors concluded that the use of an anabolic steroid caused an expectation of aggression rather than an actual increase in aggression. However, it should be noted that the study did not reflect the use of anabolic steroids in a naturalistic setting; it only lasted one week and only low doses of a single anabolic steroid were used.

Bahrke et al. (1992) investigated the effect of anabolic steroid use on mood states and behaviour in men. They found no significant differences between current users (n=12), past users (n=14) and non-users (n=24) of anabolic steroids on ratings of hostility, tension anxiety, depression, anger, fatigue, confusion and vigour. Although the steroid-using subjects reported increased feelings of enthusiasm, aggression, irritability, insomnia and libido, the changes were too subtle to be measured by the instruments used to assess these mood states.<sup>4</sup> Malone et al. (1995), in a

study of 164 weightlifting and bodybuilding subjects, also found no significant differences in aggression and hostility between current users (n=31), past users (n=46) and non-users of anabolic steroids (n=87).

Two long-term studies have found no link between anabolic steroid consumption and increased aggression. A five-year trial conducted by Millar (1994) found that side effects were minimal and reversible and that subjects experienced no problems with aggression. The one-year trial of the World Health Organisation reported no increases in aggression (WHO Task Force on Methods for the Regulation of Male Fertility 1990). It is noteworthy, however, that these studies had several common characteristics: the subjects were under medical supervision, they involved low to moderate doses of anabolic steroids and there was high compliance by subjects with the dose regime.

It is apparent from this examination of the literature that studies on the relationship between aggression and anabolic steroid use have produced inconsistent findings. One possible explanation for the negative findings may lie in the dose-response relationship between anabolic steroid use and aggression; generally speaking, the higher the dose, the greater the aggressive response (Kouri et al. 1995; Parrot, Choi & Davies 1994; Choi, Parrot & Cowan 1989; Pope & Katz 1988). This dose-response relationship may explain why subjects in studies involving low dosages of steroid use (e.g. Millar 1994; WHO Task Force on Methods for the Regulation of Male Fertility 1990) have not shown increases in aggressive behaviour. Another explanation for the negative findings may lie in the fact that some anabolic steroid use appears to produce a stronger aggressive response in some individuals than in others. Studies which have not found a significant relationship between anabolic steroid use and aggression may have had insufficient sample sizes to detect significant differences between groups (e.g. Malone et al. 1995; Bahrke et al. 1992).

The interpretation of data showing a positive relationship between anabolic steroid use and aggression, however, is also clouded by uncertainty. The social sanctions which normally inhibit overt displays of aggression appear to be relaxed in the gym, where there is positive reinforcement for aggressive

acts (Klein 1993). Indeed, aggression is seen as a desirable emotion as it improves the training intensity (Klein 1993; Bahrke, Yesalis & Wright 1990). The overt expression of aggression is common in the weight training subculture and is evident in both the language used and the behaviour displayed (Yesalis & Bahrke 1995; Ardito et al. 1994; Rada, Kellner & Winslow 1976). Terminology such as 'blitzing', 'bombing' and 'attacking' the weights reflect the aggressive attitude of the lifters towards their weights. Physical (slapping the face) and verbal expressions (shouting, abusing) of aggression are common and may be self-directed or directed at another person (usually the training partner; Klein 1993). It is noteworthy that Parrot, Choi and Davies (1994) found that anabolic steroid users report significantly higher aggression towards objects, verbal aggression and aggression during training, but not physical aggression directed towards people during the on-phase of an anabolic steroid cycle. These observations have been interpreted by some scholars as indicating that some of the association between anabolic steroid use and aggression may arise because users of anabolic steroids are exposed to subcultural norms which reinforce such aggression (Ardito et al. 1994; Klein 1993; Bahrke, Yesalis & Wright 1990; Rada, Kellner & Winslow 1976).

## CONCLUSION

Taken as a whole, the evidence we have reviewed suggests that chronic high doses of anabolic steroids are more likely to increase the risk of aggressive and/or violent behaviour than to leave it unaffected. The majority of studies appear to have found at least some evidence of an association between anabolic steroid use and aggression or violence. Those studies which have found a negative relationship generally involved small doses of steroids. At the same time, the precise role played by anabolic steroid use in the commission of aggressive acts is far from clear. It is possible that anabolic steroid use only produces aggressive or violent behaviour in persons already predisposed to such behaviour. It is also possible that at least some of the aggressive behaviour shown by those who use anabolic steroids arises from subcultural influences rather than the pharmacological effects of the drugs themselves.

Regardless of how one interprets the

available data on anabolic steroid use, there is no doubt that, at present, anabolic steroid use is a far less significant factor in the commission of violent crime than alcohol. It does not follow from this fact, however, that access to anabolic steroids should be eased. There is no guarantee that the contribution of anabolic steroid use to violent crime would remain small if the prevalence of such use increased substantially. Of course, as with all drug-use prohibitions, the restrictions on access to anabolic steroids undoubtedly generate social costs of their own. These costs will increase along with use of the drug. It is impossible to weigh these costs against those associated with more liberal access to anabolic steroids without better data than is currently available on the effects of anabolic steroid use on aggression and violence. The acquisition of such data should be a priority among health and law enforcement policy makers.

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## NOTES

- 1 Research Fellow, Centre for Health Promotion Research, Curtin University of Technology.
- 2 Research Associate, National Centre for Research into the Prevention of Drug Abuse, Curtin University of Technology.
- 3 A double blind control trial is a research term which means that neither the subjects nor the measuring investigators are aware of who is in the experimental group or placebo group (i.e. the group which appears to receive the treatment but does not receive the active ingredient of the treatment). In their study, Bhasin et al. (1996) controlled for diet, exercise intensity, other drug use and subject selection.
- 4 Bahrke et al. (1992) used the Profile of Mood States (McNair, Lorr & Droppelman 1971) and Buss-Durkee Hostility Inventory (Buss & Durkee 1957) which are common assessment tools for this type of research.

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