

High-Dose Anabolic Steroids in Strength Athletes: Effects upon Hostility and Aggression

P. Y. L. CHOI,^{1*} A. C. PARROTT¹ and D. COWAN²

¹Department of Psychology, Polytechnic of East London, Romford Road, Stratford, London E15 4LZ, UK; ²Drug Control Centre, Chelsea Kings College, Manresa Road, London SW3 60X, UK.

Six male strength athletes, three illicit anabolic steroid users and three non-steroid users were monitored over several months as they underwent normal training and competition routines. Subjects completed the Profile of Mood States (POMS) questionnaire, Buss–Durke Hostility Inventory and the Rosenweig Picture Frustration Test on four occasions: two on-drug periods and two off-drug periods for the steroid users and equivalent test periods for the non-users. Steroid presence was monitored objectively by gas chromatography coupled to mass spectrometry. Whilst those drugs declared by the athletes were confirmed in the 'on-drug' samples and most of the 'off-drug' samples, clear steroid traces were apparent in some supposed off-drug sessions. This complicated data interpretation and may partially explain why steroid users were significantly more hostile and aggressive at all times compared to the non-users. Despite this, self-rated aggression did increase significantly in steroid users during their acknowledged on-drug periods. Multiple drug use or 'stacking' in particular caused severe hostility/aggression; one steroid user also admitted to attempted murder during a previous steroid-taking phase.

KEY WORDS—Anabolic steroids, aggression, hostility, athletic performance, feeling state, testosterone, sex hormone.

INTRODUCTION

Since the 1950s increasing numbers of athletes have taken anabolic steroid drugs in order to increase muscle mass, strength and power. The male sex hormone testosterone and several synthetic analogues are available in both oral and injectable forms (Lamb, 1984). Oral substances include methyl-testosterone, fluoxymesterone and stanozolol; injectables include nandrolone, testosterone propionate and stanozolol. Confidential surveys and the testimonies of former users and coaches suggest that around 80–100 per cent of national/international standard bodybuilders, weightlifters and field athletes use anabolic steroids (Lamb, 1984). Their use is also pervasive at club level (Taylor, 1982).

Kibble and Ross (1987) have reviewed studies concerned with the side-effects of anabolic steroids, but much of their evidence comes from studies involving anabolic steroid use for medical indications such as impotence, malnutrition or skeletal disorders. It is difficult to extrapolate these data to anabolic steroid use by athletes, largely because the dosage regimens adopted by athletes are very

different from those used medically. With medical studies dosages are within the normal range, but with athletes it is not uncommon for the dose level to exceed 1 mg/kg of body weight per day with a substantial number of these individuals using two or more times that quantity (Wright and Stone, 1985). Furthermore, athletes often administer several steroids simultaneously, again at these high dose levels (Lamb, 1984; Kibble and Ross, 1987; Pope and Katz 1988). Nevertheless, reports of hepatic, endocrinological, cardiovascular, skeletal and subjective adverse effects of anabolic steroid use have been documented from the low-dose studies.

Behavioural changes anecdotally reported include increased aggressiveness, euphoria, diminished fatigue, changed libido and mood swings, all dissipating when drug-taking ceases (Goldman, 1984; Kibble and Ross, 1987). The results of experimental studies have tended to depend on the dose level used, however. In a *low-dose* double-blind trial carried out by Freed *et al.* (1975) with 13 male weightlifters the only behavioural side-effect reported during the informal unstructured interviews was diminished fatigue. But when Strauss *et al.* (1985) interviewed 10 female weight-trained athletes who were using various *high-dose* drug

* Correspondence should be addressed to P. Y. L. Choi at Department of Psychology, University College London, Gower Street, London WC1E 6BT, UK.

combinations (the greatest of which was five anabolic steroids taken simultaneously with total dosage amounting to approximately nine times the manufacturer's recommended dose), increased libido (60 per cent) and increased aggression (80 per cent) were reported. Subjects also stated that their increased aggression, while enhancing training and competing motivation, also led to problems in interpersonal relationships. Other high-dose studies have associated euphoria, irritability, paranoid ideation and depression with anabolic steroid use (Haupt and Rovere, 1984; Freinhar and Alvarez, 1985; Pope and Katz 1987, 1988).

The aim of the present study was to conduct an 'open' investigation of effects of high-dose anabolic steroids upon mood states. Mood states were measured by a range of standardized psychological questionnaires: the Buss-Durke Hostility Inventory (Buss, 1961), the Profile of Mood States (McNair *et al.*, 1980) and the Rosenweig Picture Frustration Test (Rosenweig, 1978). The study was longitudinal with steroid users being monitored once before, twice during and once after a period of drug use. Non-user controls were tested at equivalent times. Drug status was objectively assessed at each test session by mass spectrometry of urine samples.

METHOD

Subjects

The steroid user group comprised three strength athletes who had self-administered anabolic steroids for 1.5–5 years. Each subject was assessed four times, once off-drug, twice on-drug and then once again off-drug (ABBA design). A control group of three non-steroid user strength athletes were tested in parallel. Subject details are summarized in Table 1.

Three methods were employed in the attempt to recruit subjects: approaching bodybuilders known (personally) as probable anabolic steroid users, poster adverts at local gyms and bodybuilding contests and lastly through an article in *Sport & Fitness Magazine*. Ten steroid users were initially interviewed. Of the ten, three were unsuitable for the study as their drug-taking was continuous rather than intermittent. The remaining seven agreed to be tested but four repeatedly failed to turn up for appointments and eventually withdrew. The remaining three subjects provided full data. Obtaining non-user subjects was straightforward in comparison. They were selected on the basis of

Table 1. Subject details

	Age (years)	Training experience (years)	Sport
<i>Users</i>			
S1	22	10	Competitive bodybuilding
S2	28	8	Competitive weightlifting
S3	21	4	Non-competitive bodybuilding
<i>Non-users</i>			
S4	28	11	Competitive weightlifting
S5	29	9	Non-competitive weight training
S6	24	6	Competitive bodybuilding and powerlifting

similar age and experience to the user subjects. Each subject signed a written agreement form which stated that the experimenters were not encouraging or condoning steroid use and that testing would be confidential.

Design

Steroids are typically taken in cyclic patterns of 4–12 weeks on-drug (often involving simultaneous use of several drugs, known as 'stacking'). This is then followed by an off-drug period. Drug-taking begins with an initial period of increasing dosage followed by maximum dosage for several weeks then reduction and cessation. With an approaching competition, cessation occurs several weeks beforehand in order to be drug-free on the day. The experimental design was structured around each subject's individual cycle. Each subject was tested four times: pre-drug, approximately 2 weeks after commencement of drug-taking, 6 weeks after commencement and lastly 3 weeks post-drug.

Assessment measures

Buss-Durke Hostility Inventory (Buss, 1961)—a self-report questionnaire of 75 questions which group into three factors: aggression, hostility and guilt.

Profile of Mood States (POMS) (McNair *et al.*, 1980)—a feeling state questionnaire of 72 questions which group into six bipolar factors: anxious-

composed, hostile-agreeable, depressed-elated, unsure-confident, tired-energetic and confused-clearheaded.

Rosenweig picture frustration test (Rosenweig, 1978)—a projective test comprising cartoon-like pictures each depicting two persons involved in a mildly frustrating situation. One figure says a slightly annoying statement (e.g. I can't see you this morning even though we made the appointment yesterday). The other figure has a blank caption box into which the subject writes the reply. The test was split into four sets of six cartoons with one set given at each test session in a counter-balanced presentation order. Each written reply was scored blind by two raters.

Urine samples—these were analysed for the presence of anabolic steroids using gas chromatography-mass spectrometre (GCMS) with selected ion monitoring. Confirmatory tests for the definite identification of steroids was performed as necessary, using additional extraction and full-scan GCMS.

Interview—following the last testing an informal interview was tape-recorded with each subject.

The data were analysed by two-way split-plot analysis of variance (ANOVA) with the following factors: user group (steroid user/non-user) and drug condition (off/on-drug with off-drug values comprising the average from sessions 1 and 4, and on-drug values the average from sessions 2 and 3). This ABBA design enabled any time effects to be controlled.

RESULTS

With the Buss-Durke aggression factor there was a significant drug \times group interaction ($p < 0.05$) while the subject group effect was borderline ($p < 0.10$ two-tail, $p < 0.05$ one-tail). Steroid users therefore tended to score higher than the controls at all times throughout the study, but showed a significant increase in aggression during their on-drug periods (Figure 1). With the Buss-Durke hostility factor there was a significant group effect ($p < 0.05$) with higher hostility scores for the steroid users at all times (Figure 2). Similarly, with the POMS hostile-agreeable factor there was a significant difference between steroid users and non-users at all times ($p < 0.05$). Although the POMS hostility interaction was not significant, there was a trend for the hostility values to increase slightly for the steroid users while on-drug (Figure 3). None

of the other assessment measures produced significant ANOVA effects.

Effects reported during the informal interview confirm the significant findings of the mood state questionnaires. In addition to the increased aggression and hostility, other behavioural effects experienced included increased confidence and feelings of power (see Table 3).

The urine sample analyses confirmed that control subjects were steroid-free throughout the investigation. With the experimental subjects the drugs declared during the on-drug periods were confirmed, but steroid traces were apparent in some off-drug samples (see Table 2).

DISCUSSION

There were great difficulties in recruiting steroid-taking subjects for this study even though it was made clear that identities would not be revealed. The three user subjects successfully assessed were each personally known to P.C., herself a competitive strength athlete. However, despite these difficulties and the resulting small sample size some significant findings did emerge.

On the Buss-Durke inventory, steroid users reported feeling more aggressive ($p < 0.10$) and more hostile ($p < 0.05$) than the controls at all time periods (Figures 1 and 2). Their aggression did, however, increase further during the on-drug period (drug \times group interaction $p < 0.05$). The agreeable-hostile factor of the POMS similarly showed that the experimental group were more hostile at all times ($p < 0.05$) and although the interaction effect was not significant there was a trend towards increased hostility for steroid users during the on-drug period (Figure 3). These changes in feelings of aggression and hostility were confirmed in the interview data. All three steroid users reported increased aggression while on-drug, although two of them stressed that they thought this occurred only during training. Strauss *et al.* (1985) similarly noted that subjects reported their increased aggression was desirable for enhancing the drive to train harder. Some of Strauss's subjects, however, also reported that aggressiveness outside the gymnasium caused problems with their personal relationships. Two subjects in the present study reported hostility outside of the gymnasium and one of them admitted to violent aggression and attempted murder (see below).

All three subjects also reported large increases in self-confidence and feelings of power (Table 3).

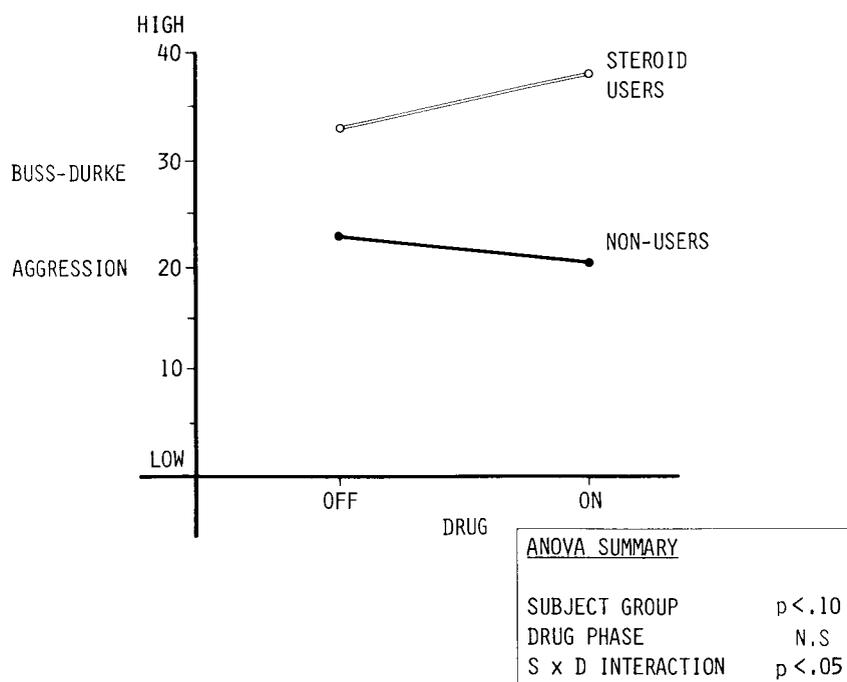


Figure 1. Buss-Durke aggression scores for steroid users during 'on'- and 'off'-drug periods; also non-users during equivalent test periods (always 'off'-drug).

They also stated that these effects ceased on drug cessation. Feeling state changes have also been reported by Pope and Katz (1988) Five of their subject group ($n = 41$) met DSM-III-R criteria for psychotic symptoms while on steroids. Four additional subjects reported mild psychotic symptoms on the SCID while five met DSM-III-R criteria for manic episode. No subject reported any of these symptoms while off steroids but major depression developed in five subjects while withdrawing from steroids.

The profile of mood changes over time did differ somewhat between subjects. Subject 2 took fluoxymesterone only (25 mg/day) and his BDI aggression scores increased only slightly while on-drug. Subject 3 tested positive for several different steroids during the on-drug phase but had traces present while supposedly off-drug. Thus the objective urine sample tests did not always verify claims for abstinence. It may be that he had been taking such large amounts during his consumption cycle that the drugs remained in his system for some time after

cessation. Alternatively he may not have been off-drug as claimed. Similar findings are frequent within the literature on smoking cessation. In a review of smoking cessation studies, Mangan and Golding (1984, p. 175) stated:

There is clear evidence of false reporting in smoking cessation programmes (Pechacek, 1979). Hence, self report data of this sort need to be supported by objective measures of which the most impressive are biological assays.

In view of this subject's positive urine result during both on-drug and off-drug periods, it is noteworthy that his BDI aggression and hostility scores were high during the supposed off-drug periods. They also increased further during the on-drug period. With Subject 1 a urine sample was not collected at the first session. During both on-drug periods several different steroids were confirmed. Furthermore, during the second on-drug session an anti-oestrogen plus L-dopa were also taken. This sub-

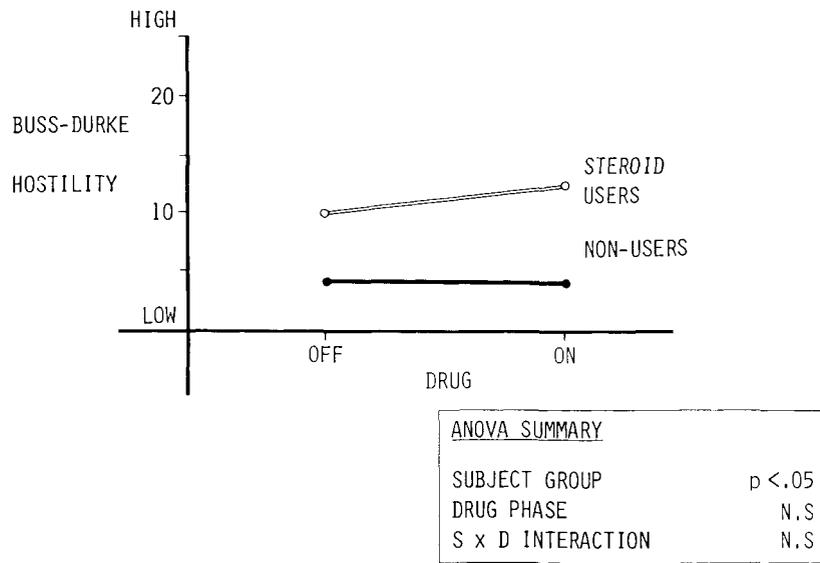


Figure 2. Buss-Durke hostility scores for steroid users during 'on'- and 'off'-drug periods; also non-users during equivalent test periods (always 'off'-drug).

ject's aggression and hostility scores were extreme while on-drug but became somewhat less severe when supposedly off-drug. During interview this subject reported severe behavioural side-effects on other drug-taking occasions. While on L-dopa (for 2 days only), hallucinations were experienced (Choi and Parrott, 1989) and this led to L-dopa being withdrawn. While solely on steroids grandiose confidence was experienced: 'I believed that absolutely nothing could hurt me'. This led him to repeatedly step out in front of moving traffic until one day he got knocked down. He also admitted to extreme hostility, physical aggression and on one occasion attempted murder: 'I followed her home ... right to her doorstep and I intended to kill her ... I grabbed hold of her ... She dropped to the floor and even though I thought her neck was broken and she was dead I still stamped on her face cos I hated her so much ... I went home and it didn't worry me. I felt no guilt ... she deserved it' (full transcript available). Pope and Katz (in press) have also described case histories of three men with no history of violence and no evidence of anti-social personality disorder who impulsively committed violent crimes and murder while taking anabolic steroids. Like Subject 3 all three men had been 'stacking'.

Changes in testosterone levels as a result of anabolic steroid administration cannot be said to definitely be aetiologic of behavioural changes. It is, however, noteworthy that none of the changes that occurred during on-drug periods were reported for off-drug periods in either the present study or the Pope and Katz (1988) study. The link between testosterone and aggression has been described in several animal species (J. Archer, unpublished). Reviews looking at the correlational evidence on testosterone levels and aggression in humans has sometimes concluded a positive relationship (Donovan, 1985), while others have found the evidence less conclusive (Rada *et al.*, 1976). In a recent review Archer (unpublished) undertook a meta-analysis of six studies looking at the relationship between Buss-Durke inventory scores and circulating testosterone levels. In unselected males the correlation of $r = +0.15$ was statistically significant ($p < 0.05$), reflecting the large sample size ($n = 180$) but numerically this value was unimpressive. Evidence from selected samples of aggressive individuals was more clear:

There is consistent evidence from five studies carried out on different types of violent male offender that they show substantially higher

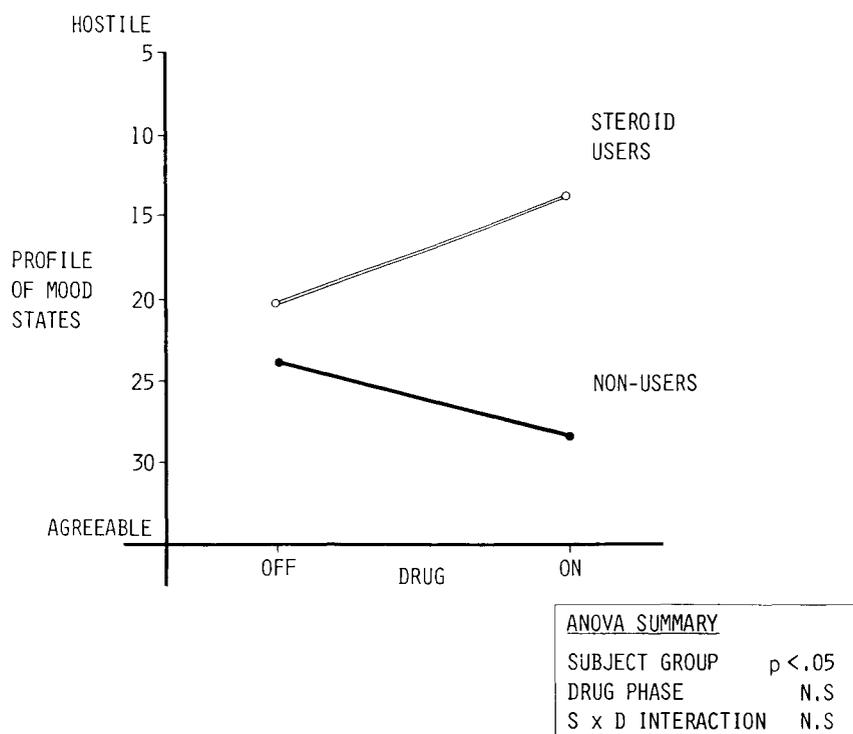


Figure 3. Profile of Mood States hostile-agreeable scores for steroid users during 'on'- and 'off'-drug periods; also non-users during equivalent test periods (always 'off'-drug).

Table 2. Urine analyses findings

	Off-drug	On-drug	On-drug	Off-drug
<i>Users</i>				
S1	No sample tested	Trembolone 50 mg/day Stonazolol 50 mg/day	Methenolone 50 mg/day Fluoxymesterone 15 mg/day Mesterolone 25 mg/day ¹	Clear
S2	Clear	Fluoxymesterone 25 mg/day	Fluoxymesterone 25 mg/day	Clear
S3	— ²	Methandinone 20 mg/day Nandrolone 200 mg/week	No sample tested	— ³
<i>Non-users</i>				
S4	Clear	Clear	Clear	Clear
S5	Clear	Clear	Clear	Clear
S6	Clear	Clear	Clear	Clear

¹ L-Dopa (DA precursor) and nolvadex (anti-oestrogen) also stated to have been taken, were not tested for as they are not anabolic steroids.

² Traces of nandrolone.

³ Traces of mesterolone, testosterone, oxymetholone, androlone and methyltestosterone were found.

Table 3. Interview findings: reported effects of steroids use

	S1	S2	S3
Muscle gain	+++	0	+++
Strength gain	+++	++	+++
Pain in joints	++	++	+++
Kidney pains	++	+	0
Heart pains	+	0	0
Water retention	+++	+	++
Penis size	-	0	0
Sex drive	0	0	+++
Aggression for training	+	+++	++
Violent aggression	+++	0	0
Hostility	++	+	0
Confidence	++	++	+++
Euphoria	++	0	+
Grandiosity	++	0	0
Feelings of power	+	+	++
Paranoia	0	+	0

- = decreased; 0 = unchanged; + = increased slightly; ++ = increased quite a lot; +++ = increased very much.

testosterone levels than those found in selected samples of less violent individuals (Archer, unpublished).

also:

Two studies of women found that samples selected on the basis of their violent history had higher testosterone levels than other samples (J. Archer, submitted for publication).

Furthermore, animal studies suggest that androgens selectively stimulate neurons associated with circuits of aggression and somatomotor activity (Strumpf and Sar, 1976) providing neurochemical evidence for the mode by which changed feeling states may occur.

Three measures of aggression were employed in the present study: Buss-Durke Inventory (BDI), Profile of Mood States (POMS) and the Rosenweig Picture Frustration Test (RPFT). Consistent and significant changes were noted with the BDI and the POMS, but the RPFT produced a totally different pattern of change. The BDI and the POMS comprise direct and descriptive statements, e.g. 'once in a while I cannot control my urge to harm others'. In contrast, the RPFT is a projective test generally scored using psychoanalytic techniques. One possible explanation for the absence of signi-

ficant change in these scores may be that an inappropriate scoring system had been used. Each item was scored blind by two raters as follows:

- 0 = no trace of aggression/anger/hostility/annoyance,
 1 = possible trace,
 2 = definitely present but mild,
 3 = moderate presence,
 4 = strong presence,
 5 = extremely strong.

This scoring system was, however, highly reliable (inter-rater correlation $r = +0.89$, $p < 0.001$). Thus, perhaps this projective test simply did not elicit responses which discriminated the different drug states. Alternatively it might be argued that a psychoanalytic scoring system should have been used.

Overall the study suffered from several experimental weaknesses. It was 'open' rather than 'blind'. Drug conditions varied widely between subjects. The supposed off-drug periods were not completely drug-free. The overall sample size was small. Nevertheless, this study does represent an advance over previous research in certain aspects. It comprised the first longitudinal study of steroid users on realistic drug dosages; the first to use standardized self-report feeling state questionnaires and lastly, it is the first where drug state was objectively monitored.

The findings of the present study indicate the clear need for research into the psychological effects of high-dose anabolic steroids. Since the 1988 Olympic Games, and the ensuing public verification that many world-class athletes do take sport-enhancing drugs, plus the acknowledged widespread use of steroids at club level (Taylor, 1982) a substantial number of people are experiencing not only enhanced sporting performance but changed mood and behaviour.

ACKNOWLEDGEMENTS

The authors wish to thank the management and staff of New River Sports Centre, Haringey, London, for providing the facilities to meet with and test subjects, and Andy Ball of the National Amateur Bodybuilders Association for help with subject recruitment.

REFERENCES

- Buss, A. H. (1961) *The Psychology of Aggression*. John Wiley, Chichester.
- Choi, P. Y. L. and Parott, A. C. (1989). Illicit drug use in strength athletes (letter). *British Journal of Psychiatry*, **154**, 732–733.
- Donovan, B. T. (1985). *Hormones and Behaviour*. Cambridge University Press, Cambridge.
- Freed, D. L. J., Banks, A. J., Lonson, D. and Burley, D. M. (1975). Anabolic steroids in athletics: a cross-over double blind trial on weightlifters. *British Medical Journal*, 471–473.
- Freinhar, J. P. and Alvarez, W. (1985). Androgen induced hypomania (letter). *Journal of Clinical Psychiatry*, **46**, 354–355.
- Goldman, R. (1984). *Death in the Locker Room*. Century Press.
- Haupt, H. A. and Rover, G. D. (1984). Anabolic steroids: a review of the literature. *American Journal of Sports Medicine*, **12** 460–484.
- Kibble, M. W. and Ross, M. B. (1987). Anabolic steroids drugs review. *Clinical Pharmacy* **6**, 686–692.
- Lamb, D. (1984). Anabolic steroids in athletics. *American Journal of Sports Medicine*, **12**, 31–38.
- Mangan, G. L. and Golding, J. F. (1984). *The Psychopharmacology of Smoking*. Cambridge University Press, Cambridge.
- McNair, D. M. Lorr, M. and Droppleman, L. F. (1980). *Profile of Mood States Manual*. Educational & Industrial Testing Service, San Diego, CA.
- Pechacek, T. F. (1979). Modification of smoking behaviour. In: *Smoking and Health*. Surgeon General Report no. PHS 79–5006. US Government Printing Office, Washington, DC.
- Pope, H. G. and Katz, D. L. (1987). Bodybuilders psychosis (letter). *Lancet*, **i**, 863.
- Pope, H. G. and Katz, D. L. (1988). Affective and Psychotic symptoms associated with anabolic steroid use. *American Journal of Psychiatry*, **145** (4), 487–489.
- Pope, H. G. and Katz, D. L. (in press). Homicide and near homicide by anabolic steroid users. *Journal of Clinical Psychiatry*.
- Rada, R. T., Kellner, R. and Winslow, W. W. (1976). Plasma testosterone and aggressive behaviour. *Psychosomatics*, **17**, 138–142.
- Rosenweig, S. (1978). *Rosenweig Picture Frustration Test Study Manual*. Rana House, St Louis, MO.
- Strauss, R. H., Wright, J. E. and Finerman, G. A. M. (1982). Anabolic steroid use and health status among 42 weight trained male athletes. *Medicine and Science in Sport and Exercise*, **14**, 119.
- Strauss, R. H., Ligett, J. E. and Lanese, R. R. (1985). Anabolic steroid use and perceived effects in 10 weight trained women. *Journal of the American Medical Association*, **253**, 2871–2873.
- Strumpf, W. E. and Sar, M. (1976). Steroid hormone target sites in the brain. *Journal of Steroid Biochemistry*, **7**, 1163–1170.
- Taylor, W. (1982). *Anabolic steroids and the athlete*. McFarland, N Carolina.
- Wright, J. and Stone, M. H. (1985). Anabolic drug use by athletes: literature review. Position paper on anabolic use by athletes. National Strength and Conditioning Association, PO Box 81410, Lincoln, Nebraska 68501, USA.