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## A preliminary investigation into the relationship between anabolic-androgenic steroid use and the symptoms of reverse anorexia in both current and ex-users

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**Abstract** *Rationale:* To establish whether the symptoms of reverse anorexia continue with the cessation of anabolic-androgenic steroid (AAS) use in male body builders. *Objective:* To determine whether current and ex-AAS-using body builders score higher on the modified (for reverse anorexia) eating disorders inventory (EDI) than both non-AAS-using body builders and regular aerobic exercisers. *Methods:* A random sample of regular aerobic exercisers, current, ex-, and non-AAS-using body builders were recruited from four local gyms and a syringe exchange in the Merseyside area. A total of 137 male subjects with an average age of 29 years (range 17–49 years) were recruited. Fifty subjects were classed as aerobic exercisers, 39 subjects were classed as non-AAS-using body builders, 29 subjects were current AAS users and 19 subjects were ex-AAS users. All subjects undertook an anonymous questionnaire consisting of the modified EDI, the severity of dependence scale (SDS) for both exercising and AAS use, and questions about body weight, dieting, and substance use. *Results:* AAS-using bodybuilders were striving towards an exaggerated mesomorphic physique. Both current and ex-AAS users had higher scores on all sections of the EDI than both groups of non-AAS users. There was a significant positive correlation between the SDS scores for AAS and scores on the EDI for current AAS users. *Conclusions:* AAS use, but not body building per se, was associated with increased symptoms of reverse anorexia, and this symptomatology was higher in those who had higher scores on the SDS for AAS. It remains to be determined whether symptoms of reverse anorexia are either a cause or an effect of AAS use.

**Keywords** Anabolic-androgenic steroids · Reverse anorexia · Dependence · Eating disorders

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### Introduction

Body dissatisfaction and weight preoccupation are widespread among women during adolescence and early adulthood (Miller 1980; Wadden et al. 1991). However, it is now recognised that males also report body dissatisfaction, known as the ‘Adonis Complex’ (Pope et al. 2000). Eating disorders are sexually dimorphic, with anorexia and bulimia nervosa being much more frequent in females, and males representing less than 15% of all cases (Kaplan and Garfinkel 1995). Adolescent males are reported to be concerned with both weight and shape, but females are predominantly concerned about weight. The effects of testosterone in males at puberty, reinforced by socio-cultural norms, has tended to emphasise a mesomorphic, athletic appearance for men (Wroblewska 1997). This is incompatible with the severe starvation seen in cases of anorexia, as there is a tendency for males to burn excess calories through exercise rather than cutting or purging them (Pope et al. 2000). In fact male body dissatisfaction is commonly associated with feelings of being underweight rather than overweight (Mintz and Betz 1986; McCauley et al. 1988; Blouin and Goldfield 1995; Wroblewska 1997).

Reverse anorexia is the term used for individuals who perceive that they are too small and/or insufficiently muscular (Pope et al. 1993, 2000). Reverse anorexics have a chronically distorted perception of their own size, similar to that seen in anorexia. It has been suggested that both anorexia and reverse anorexia are disorders related to body dysmorphic disorder, with each reflecting the cultural expectations of the individuals’ group (Pope et al. 1993). Reverse anorexia is reported to be most prevalent amongst body builders but it is also found in other male gym users (Pope et al. 2000). It is probable that males who see themselves as underweight may start body building in order to attain an exaggerated ‘hypermesomorphic’ look (Mishkind 1986; Wang et al. 1994).

Anabolic-androgenic steroids (AASs) have been used widely since the 1960s, and use is on the increase

(Katz and Pope 1990; Yesalis 1992; Korkia 1994; Irving et al. 2002). In the UK, the British Crime Survey indicates that 1% of 16- to 59-year olds have ever used steroids (Ramsey et al. 2001). However, 9.2% of male and 2.3% of female gym users report having used AASs and 6% of males and 1.4% of females were still currently using (Korkia and Stimson 1993). At gyms where heavy weight training equipment is available and the clients are predominantly male, the proportion of current AAS users increases to 29.5%. In contrast, gyms with an emphasis on cardiovascular training and a mixed-gender clientele, only 1.5% reported AAS use (Lenehan et al. 1996a). AAS use is associated with a number of adverse medical and psychiatric effects, including liver damage, depression, mania, dependence, and the risks associated with intravenous drug use (Pope and Katz 1988, 1992, 1994; Brower et al. 1991; DuRant et al. 1993; ISDD 1993).

The illegal use of AASs poses a serious public health problem and in order to prevent or reduce the harm associated with their use it is necessary to establish whether there are any associated long-term risks. Whilst previous research has focused on the risk factors for the initiation of AAS use and the complications of their use, there has been little work on the psychological effects of discontinuing AAS use. It was hypothesised that there is a relationship between the symptoms of reverse anorexia and AAS use in male body builders. In order to determine whether reverse anorexia is a substance-induced disorder, individuals who had ceased using AASs were also included. It was hypothesised that if reverse anorexia is a substance-induced disorder that the symptoms would resolve with abstinence.

## Methods

### Subjects

A total of 137 male subjects were randomly recruited from four gyms and a syringe exchange in the Merseyside area. As AAS use is so low in women, no female subjects were recruited. These subjects were separated into four groups; (i) cardiovascular (defined as individuals who exercised regularly but not to enhance body mass;  $n=50$ ), (ii) body builders (defined as individuals who exercised in order to increase bodyweight) who reported that they had never used AASs ( $n=39$ ), (iii) body builders who had used AAS in the past (at least over 3 months prior to the study in order to remove withdrawal effects;  $n=19$ ), and (iv) body builders who were currently using AASs (or in the previous 3 months for those who used intermittently;  $n=29$ ). The gyms where the recruitment occurred have policies of banning individuals who are found to be illegally using AASs; so, in this context, it was felt that urinalysis would negatively affect recruitment. AAS use was therefore based on self-report alone. Pope and Katz (1994) found that self-reported AAS use was accurate when compared with urinalysis. Other studies have not reported discrepancies between self-report and urinalysis indicating that it is a reliable measure in this context (Bond et al. 1995). Subjects were not excluded from the study if they had illegally used other controlled drugs.

### Measures

The subjects undertook an anonymous questionnaire that consisted of the eating disorders inventory (EDI) (Garner et al. 1983), the severity of dependence scale (SDS) (Gossop et al. 1995), and questions about body weight and controlled drug use.

The EDI has 64 items that form 8 subscales. The individual subscales are; (i) perfectionism, (ii) drive for thinness, (iii) ineffectiveness, (iv) interpersonal distrust, (v) interoceptive awareness, (vi) bulimia, (vii) maturity fears, and (viii) body dissatisfaction. Items on the scale were assessed using a 6-point Likert scale. The EDI has proven reliability and validity with a range of populations (Allison 1995). The EDI was modified for this study in order for the body parts included in the body dissatisfaction subscale to be more appropriate for men.

The SDS is a short 5-item scale which can be used to rapidly assess the severity of dependence for a wide range of drugs (Gossop et al. 1995). It is concerned with the individual's feelings of impaired control and their preoccupations and anxieties over their drug taking. All five items load onto a single factor and it has proven reliability and validity (Gossop et al. 1995). This scale was also used to measure whether the same sort of dependence problems would be observed in relation to attending the gym and engaging in exercise. The SDS was primarily developed to assess drug dependence and therefore it has questionable validity in this context. However, it was felt that using the scale in this way would give a reasonable indication of any dependence-type problems with exercising in the gym.

The self-report questionnaire consisted of socio-demographic questions (age, marital status, occupation, and number of years in education after school) and questions about current height and weight, highest and lowest weight as an adult, and ideal weight. Dieting questions included self-reports of deliberately increasing or reducing food intake due to concerns about body size or weight and at what age these concerns began. Exercise questions were aimed at identifying how often the subjects engaged in cardiovascular and body-building exercises and the percentage of these exercises that were aimed at controlling body weight and/or enlarging body mass. A brief assessment of past and current drug use was used to assess the use of controlled drugs. AAS use was determined by assessing the preparations used, doses and duration used, age at which AAS use started and reasons for starting AAS use.

### Ethics

Ethics approval was granted by the St Helens and Knowsley Local Research Ethics Committee. Due to the requirement for anonymity surrounding the illegal use of controlled drugs, the ethics committee agreed to the use of verbal informed consent.

### Statistics

Data were statistically analysed using the software package SPSS for Windows (*v10.07*; SPSS Inc, USA). One-way ANOVAs were used to detect for differences between the means for continuous variables. Tukey's honest significant difference test was used as the post-hoc test. Pairwise multiple comparison procedures were used because the four groups were all conditions with none acting as control. Kruskal Wallis tests were used to detect differences for ordinal data, Dunn's method as the post-hoc test. Independent *t*-tests were also used. All correlations used Spearman's Rho due to the non-parametric nature of the data.

**Table 1** Mean ( $\pm$ SD) height and weight measurements between the cardiovascular group ( $n=50$ ), body-building group ( $n=39$ ), ex-anabolic-androgenic steroid (AAS) users ( $n=19$ ), and current AAS users ( $n=29$ )

Measurement	Cardiovascular	Body builders	Current AAS users	Ex-AAS users
Height (cm)	177.0 $\pm$ 8.7	180.5 $\pm$ 5.5	180.8 $\pm$ 6.3	181.2 $\pm$ 5.5
Weight (kg)	82.7 $\pm$ 14.4 <sup>a</sup>	80.1 $\pm$ 8.7 <sup>b</sup>	89.7 $\pm$ 11.9	86.3 $\pm$ 7.8
Body mass index	26.4 $\pm$ 3.9	24.5 $\pm$ 2.3 <sup>*c</sup>	27.4 $\pm$ 2.9	26.3 $\pm$ 2.1
Lowest weight (kg)	74.1 $\pm$ 12.8	70.2 $\pm$ 7.7	73.9 $\pm$ 10.9	73.7 $\pm$ 7.6
Highest weight (kg)	88.2 $\pm$ 17.9	84.7 $\pm$ 10.4	96.3 $\pm$ 20.7 <sup>@</sup>	96.9 $\pm$ 9.5 <sup>@</sup>
Ideal weight (kg)	80.2 $\pm$ 11.3 <sup>b</sup>	81.5 $\pm$ 8.3 <sup>b</sup>	95.0 $\pm$ 14.3	89.3 $\pm$ 9.2 <sup>*</sup>

<sup>a</sup>  $P<0.05$  <sup>b</sup>  $P<0.01$  <sup>c</sup>  $P<0.001$  vs current AAS users

<sup>\*</sup>  $P<0.01$  vs the cardiovascular group

<sup>@</sup>  $P<0.05$  vs the body-building group

**Table 2** Mean ( $\pm$ SD) eating disorders inventory (EDI) scores between the cardiovascular group ( $n=50$ ), body-building group ( $n=39$ ), ex-anabolic-androgenic steroid (AAS) users ( $n=19$ ), and current AAS users ( $n=29$ )

EDI subscale	Cardiovascular	Body builders	Current AAS users	Ex AAS users
Perfectionism	3.5 $\pm$ 3.3 <sup>*</sup>	3.5 $\pm$ 3.6 <sup>*</sup>	5.2 $\pm$ 4.6	8.1 $\pm$ 5.3
Drive for thinness	1.7 $\pm$ 2.1 <sup>*a</sup>	2.1 $\pm$ 2.7 <sup>**a</sup>	5.0 $\pm$ 4.8	5.1 $\pm$ 3.9
Bulimia	0.7 $\pm$ 1.6 <sup>**</sup>	1.0 $\pm$ 2.3 <sup>**</sup>	1.5 $\pm$ 2.3	2.7 $\pm$ 2.2
Body dissatisfaction	5.0 $\pm$ 4.6 <sup>**a</sup>	6.3 $\pm$ 4.1 <sup>c</sup>	9.4 $\pm$ 4.9	9.5 $\pm$ 5.1
Ineffectiveness	1.2 $\pm$ 1.6 <sup>**b</sup>	1.4 $\pm$ 1.9 <sup>**b</sup>	3.5 $\pm$ 4.4 <sup>***</sup>	5.7 $\pm$ 4.3
Interpersonal distrust	2.2 $\pm$ 2.1 <sup>*a</sup>	2.1 $\pm$ 2.6 <sup>*a</sup>	5.1 $\pm$ 4.6	6.3 $\pm$ 3.9
Interceptive awareness	1.2 $\pm$ 1.7 <sup>*a</sup>	1.1 $\pm$ 2.3 <sup>*a</sup>	3.0 $\pm$ 3.2	5.7 $\pm$ 4.1
Maturity fears	3.7 $\pm$ 3.7 <sup>**c</sup>	2.3 $\pm$ 1.9 <sup>*a</sup>	6.4 $\pm$ 6.0	6.6 $\pm$ 4.4
Total EDI score	19.3 $\pm$ 12.8 <sup>*a</sup>	19.7 $\pm$ 13.3 <sup>*a</sup>	39.6 $\pm$ 25.9	52.9 $\pm$ 22.6

<sup>\*</sup>  $P<0.001$  <sup>\*\*</sup>  $P<0.01$  <sup>\*\*\*</sup>  $P<0.05$  vs ex-AAS users

<sup>a</sup>  $P<0.001$  <sup>b</sup>  $P<0.01$  <sup>c</sup>  $P<0.05$  vs current AAS users

## Results

### Socio-demographic data

There were no age differences between the four groups ( $F_{3,133}=1.80$ , n.s.). As can be seen in Table 1, there was a significant height difference ( $F_{3,133}=2.98$ ,  $P=0.03$ ) but as the statistical power of the test was low, the conservative post-hoc tests failed to show where this difference lay. The subjects in the cardiovascular group were 4 cm shorter than those in the other three groups and it is probable that this accounted for the result. There were no significant differences in either education ( $F_{3,133}=2.60$ ,  $P=0.06$ ) or employment status ( $\chi^2_3=2.11$ , n.s.).

There was a significant difference in the current weight of the groups ( $F_{3,133}=4.24$ ,  $P=0.007$ ), with the current AAS users being heavier than those in both the cardiovascular ( $P<0.05$ ) and the body-building ( $P<0.01$ ) groups. There were also significant differences ( $F_{3,133}=5.14$ ,  $P=0.002$ ) between the groups for current body mass index (BMI), with both the cardiovascular group ( $P<0.01$ ) and the current AAS users ( $P<0.001$ ) having a higher BMI than those in the body-building group. There were no significant differences in the lowest weight as an adult ( $F_{3,133}=1.15$ , n.s.), but there was in the highest weight as an adult ( $F_{3,133}=4.34$ ,  $P=0.006$ ). The body-building group had never been as heavy as either the current ( $P<0.05$ ) or the ex-AAS users ( $P<0.05$ ). The self-reported ideal weight also differed significantly ( $F_{3,133}=13.13$ ,  $P<0.001$ ), with the current AAS users wanting to be heavier than those in both the cardiovascular ( $P<0.01$ ) and the body-building groups ( $P<0.01$ ). The ex-AAS

users also reported wanting to be heavier than those in the cardiovascular group ( $P<0.01$ ).

There was no difference in the number of individuals from each group that had ever restricted their food intake in order to lose weight ( $\chi^2_3=5.97$ , n.s.). There was, however, a significant difference in the number who had ever deliberately increased their food intake in order to gain weight ( $\chi^2_3=32.38$ ,  $P<0.001$ ). This was much more likely in both current ( $P<0.05$ ) and ex-AAS user groups ( $P<0.05$ ) than the cardiovascular group.

### EDI scores

As can be seen in Table 2, there were significant differences in total EDI scores for the four groups ( $F_{3,133}=22.90$ ,  $P<0.001$ ). The current and ex-AAS users both scored higher than the cardiovascular and body building groups ( $P<0.001$  in all cases). The difference between current and ex-AAS users approached statistical significance ( $P=0.057$ ). There were significant differences on the perfectionism subscale ( $F_{3,133}=7.20$ ,  $P<0.001$ ), with the ex-AAS users scoring higher than those in both the cardiovascular ( $P<0.001$ ) and body-building ( $P<0.001$ ) groups. Significant differences were found in the drive for thinness ( $F_{3,133}=9.83$ ,  $P<0.001$ ), with both the current and ex-AAS users scoring higher than those in both the cardiovascular ( $P<0.001$  for both) and body-building ( $P<0.001$  and  $P<0.01$ , respectively) groups. The scores on the Bulimia subscale were significantly different ( $F_{3,133}=4.46$ ,  $P=0.005$ ), with only the ex-AAS users scoring higher than both the cardiovascular ( $P<0.01$ ) and body-building ( $P<0.01$ ) groups. Body

dissatisfaction subscale scores were significantly different ( $F_{3,133}=7.99, P<0.001$ ), with both the current and ex-AAS users scoring higher than the cardiovascular group ( $P<0.001$ ). However, only the current AAS user scores were statistically significantly higher than those the body-building group ( $P=0.026$ ), with the increase in ex-AAS users' scores approaching statistical significance ( $P=0.057$ ). On the ineffectiveness subscale, there were also significant differences ( $F_{3,133}=14.29, P<0.001$ ), with the ex-AAS users scoring higher than those in the cardiovascular and body-building groups ( $P<0.001$ ) and the current AAS users ( $P<0.05$ ). The current AAS users scored higher than those in the cardiovascular ( $P<0.01$ ) and body-building ( $P<0.01$ ) groups. There were significant differences on the interpersonal distrust subscale ( $F_{3,133}=12.63, P<0.001$ ), with both the current and ex-AAS users scoring higher than the cardiovascular and body-building groups ( $P<0.001$  in all cases). Scores on the interoceptive awareness subscale were significantly different ( $F_{3,133}=17.32, P<0.001$ ), with the ex-AAS users scoring higher than the cardiovascular and body-building groups ( $P<0.001$ ) and the current AAS users ( $P<0.01$ ). The current AAS users scored higher than those in the cardiovascular ( $P<0.01$ ) and body-building ( $P<0.01$ ) groups. Significant differences were also found on the maturity fears subscale ( $F_{3,133}=8.28, P<0.001$ ), with both the current and ex-AAS users scoring higher than those in the cardiovascular ( $P<0.01$  and  $P<0.05$ , respectively) and the body-building ( $P<0.001$ ) groups.

#### Other drug use and SDS scores

There was little illegal use of controlled drugs in the sample (data not shown) and therefore no statistics were run. The mean ( $\pm$ SD) SDS score for current AAS use was  $4.0\pm 2.5$ , and it was  $5.3\pm 2.9$  for ex-AAS use. In the overall sample, the mean SDS ( $\pm$ SD) score for exercise/going to the gym was  $3.3\pm 2.3$ . There was a significant positive correlation between scores on the SDS and total EDI scores in the current AAS users ( $r=0.58, P=0.001$ ). There was no relationship, however, between scores on the SDS and total EDI scores for the ex-AAS users ( $r=0.17, n.s.$ ). These groups were analysed separately because of the difference in the drug use (i.e. past versus current) that the SDS was measuring.

## Discussion

The socio-demographic data indicate that there are different reasons for engaging in exercise. The cardiovascular group wanted to be on average 2.5 kg lighter and they were the only group that had an ideal weight that was lower than their current weight. They appear to exercise in order to keep their weight down, by doing predominantly aerobic exercise. They did the least amount of body-building exercise and were not aiming to enlarge their bodies. The body-building group were the lightest

and had never been as heavy as the other groups, but their ideal weight was equivalent to that of the cardiovascular group. Around 50% of this group had increased their food intake due to concerns about their body mass. Despite having the highest current weight, the current AAS users wanted to gain weight (presumably in the form of lean muscle mass) by around 5.5 kg on average. Nearly 85% of this group had deliberately increased their food intake. The ex-AAS users wanted to be 3 kg heavier on average, and in this group nearly 85% had increased their food intake in order to gain body mass. All of the body-building groups did very little aerobic exercise and spent most of their time doing exercise to increase body mass.

The BMI was used as a measure of whether the subjects were overweight for their height. The mean BMI of the cardiovascular group, current and ex-AAS users were all outside of the 'normal' BMI range of 20–25. However, it is not possible to determine whether these men were overweight or very muscular without measuring adipose tissue or total body fat mass. Only the body-building group fell within the normal BMI range. Even though the AAS users were outside of the 'normal' BMI range, they wanted to increase it, only the cardiovascular group wanted to decrease their BMI. These data suggest that only those in the cardiovascular and body-building groups were aiming to stay within the 'normal' BMI range, with the AAS users aiming for a hypermesomorphic body shape. The current AAS users had an 18-kg difference between their ideal weight and uncontrolled weight, but the ex AAS users had only a 4-kg difference. This may be one factor that maintains AAS use in these subjects.

The majority of the current AAS users reported that they initiated AAS use in order to gain size and strength and/or to improve body building and this is consistent with other studies (O'Connor and Lenehan 1994; Lenehan et al. 1996b). A minority of the subjects reported AAS use to improve their appearance and this is also consistent with previous work (Williamson 1993; O'Connor and Lenehan 1994; Bridge 1996). For these users, concerns about their weight began approximately 2.5 years before their first AAS use. As this is based on retrospective self-reporting, there may be a recall bias, but it would be reasonable to assume that these concerns preceded AAS use. This is consistent with previous work indicating that body weight concerns, and in particular feelings of not feeling big enough (symptoms of reverse anorexia), leads to AAS use (Pope et al. 1993; Irving et al. 2002).

In agreement with previous work, the AAS users scored higher on the modified EDI than those in both the cardiovascular and body-building groups, indicating that there is an association between AAS use and symptoms of reverse anorexia (Blouin and Goldfield, 1995; Schwerin et al. 1996, 1997). Both the cardiovascular and body-building groups scored in the range of the norms for male college populations (Garner and Olmsted 1984; Allison 1995). There were also no significant differences between these two groups. Therefore body building per se was not associated with the symptoms of reverse anorexia.

There was a positive correlation between scores on the SDS (for AAS) and the EDI for current users but not for the ex users. It is possible that recalling past behaviour may be inaccurate and this explains the discrepancy. The scores on the SDS for both AAS and exercise were comparable to those reported for drugs of dependence (Gossop et al. 1995). This suggests that individuals with symptoms of reverse anorexia are more likely to be dependent on AAS. The reliability and validity of this measure have not been adequately assessed for AAS and exercise, however, and therefore caution is warranted in the interpretation of these data.

As with all community-based studies of illegal users of controlled drugs using self-report measures, there are methodological limitations. The reliance on self-report data and the recruitment of current AAS users from a syringe exchange may have constituted sources of experimental bias. Urinalysis would have greatly enhanced confidence in the accuracy of the self-reporting and future studies should use this as an objective measure of AAS use. In addition, several gym managers would not even allow questions about AAS use to be asked in their gyms. This represents a key difference between field and laboratory research; despite the desirability of urinalysis to confirm AAS use, it may prove impractical to do so in certain circumstances. The participation rate was low due to the consequences of admitting AAS use in the gyms and this may have led to a selection bias. The low number of subjects who admitted use of AAS is problematic but the numbers reflect the relatively low numbers found in epidemiological studies. The EDI was altered in the same way as previous work (Blouin and Goldfield 1995), and this may have altered its reliability and validity. Taken together these factors indicate that these data should be interpreted cautiously.

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## Conclusions

AAS use, but not body building per se, was associated with increased symptoms of reverse anorexia and this symptomatology was higher in those who had higher scores on the SDS for AAS. It remains to be determined whether symptoms of reverse anorexia are either a cause or an effect of AAS use.

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