

Physical appearance concerns are uniquely associated with the severity of steroid dependence and depression in anabolic–androgenic steroid users

SCOTT GRIFFITHS¹ , BRENDAN JACKA² , LOUISA DEGENHARDT² ,
STUART B. MURRAY³ & BRIONY LARANCE²

¹Melbourne School of Psychological Sciences, University of Melbourne, Melbourne, Australia, ²National Drug and Alcohol Research Centre, University of New South Wales, Sydney, Australia, and ³Department of Psychiatry, University of California, San Francisco, USA

Abstract

Introduction and Aims. Emerging research suggests that the sub-population of anabolic–androgenic steroid (AAS) users who experience physical appearance concerns may suffer greater psychological dysfunction than other sub-populations, including users with athletic or occupational concerns. Thus, among current AAS users, we sought to determine whether, and to what extent, social physique anxiety—an established measure of appearance concern—was associated with psychological dysfunction. **Design and Methods.** Interviews were conducted with a sample of 74 male AAS users living in Australia. Users completed self-report instruments of the severity of AAS dependence, depression, hazardous and risky drinking, use of non-AAS illicit drugs, psychological side-effects due to AAS use and abnormal test results due to AAS use. **Results.** Multivariate analyses revealed that greater social physique anxiety was uniquely associated with more severe symptoms of both AAS dependence and depression. Moreover, the effect size of these relationships was large. Social physique anxiety was not associated with hazardous or risky drinking, non-AAS illicit drug use, psychological side-effects or abnormal test results. **Discussion and Conclusions.** Limitations notwithstanding, the study is consistent with the notion that AAS users who experience appearance concerns are at heightened risk of co-morbid psychological dysfunction. Given trends indicating an increase in the prevalence of AAS use in Australia and elsewhere, the findings suggest that health-care systems may need to consider prioritising the sub-population of AAS users who experience appearance concerns. Further investigation of the clinical syndrome of AAS dependence is required, including its relation to body image and eating disorders. [Griffiths S, Jacka B, Degenhardt L, Murray SB, Larance B. Physical appearance concerns are uniquely associated with the severity of steroid dependence and depression in anabolic–androgenic steroid users. *Drug Alcohol Rev* 2018]

Key words: anabolic steroid, body image, social physique anxiety, anabolic steroid dependence, depression.

Introduction

The non-medical use of anabolic–androgenic steroids (AAS) is increasing in prevalence among people who inject drugs in Australia [1] and potentially elsewhere [2]. AAS users are a heterogeneous population with differing concerns underlying their AAS use, including, most notably, concerns about one's physical appearance, athletic performance and occupational performance [3–16]. An understanding of these differing concerns is critical to inform prevention, early intervention, treatment and harm reduction services for AAS. To this end, a small and growing body of

literature suggests that AAS users who experience physical appearance concerns also experience elevated rates of co-morbid psychological dysfunction, and in particular, eating disorder and muscle dysmorphia symptomatology, than users who experience performance concerns [6]. Further, AAS users who experience appearance concerns may also be more impulsive, conferring a greater level of risk for the health consequences of AAS use. To this end, Underwood [17] conducted a qualitative study of body-builders motivated exclusively by appearance concerns and reported that those who used AAS tended to allow their appearance concerns to override the health

Scott Griffiths, PhD, Postdoctoral Research Fellow, Brendan Jacka, PhD, Postdoctoral Research Fellow, Louisa Degenhardt, PhD, Principal Research Fellow, Stuart B. Murray, PhD, DClinPsych Assistant Professor, Briony Larance, PhD, Senior Research Fellow. Correspondence to Dr Scott Griffiths, Melbourne School of Psychological Sciences, University of Melbourne, Office 606, Redmond Barry Building, Melbourne, VIC 3010, Australia. Tel: +61 4 24 207 654; E-mail: scottgriffiths@gmail.com; scott.griffiths@unimelb.edu.au

complications of their AAS use. This is an important signal for quantitative research to further investigate.

To-date, scant research has directly examined whether there is a positive relationship between the degree of appearance concerns experienced by AAS users and psychological dysfunction related to AAS use. Given that appearance concerns are a major reason for AAS use (e.g. [4,6,9,16]), and that appearance concerns among males are both widespread [18] and increasing [19], there is a clear need for research examining this issue. The aim of this study was to examine whether the degree of appearance concern among AAS users, as indicated by social physique anxiety, is associated with higher levels of psychological dysfunction. Social physique anxiety refers to an individual's experience of anxiety about others' judgement of their physique in social settings [20–22]. It was primarily hypothesised that AAS users with greater social physique anxiety would experience higher levels of psychological dysfunction, including greater severity of AAS dependence, depression, hazardous and risky drinking, use of non-AAS illicit substances, more frequent psychological side-effects due to AAS use, and more frequent abnormal biological test results (e.g. tests of endocrine function).

Methods

Recruitment

AAS users were recruited using two methods, namely, purposive sampling and snowballing. The former method focused on a range of sources known to be accessed and/or frequented by AAS users, including needle and syringe program sites, gyms, supplement stores, online forums and social media channels. Geographically, recruitment was restricted to users living in the Sydney and Blue Mountains region of New South Wales, Australia.

Study procedures

The wider study involved three modes of data collection: an in-depth interview, an online survey and a self-report survey. The current study focuses only on the sub-sample of participants who received an in-depth interview because the data of primary interest to the current study were only collected during these interviews. The interviews were conducted from December 2014 to August 2015 and lasted, on average, for 42 min (range = 30–60 min). Most interviews were conducted face-to-face using computer-based communication software while a minority of interviews were conducted over the phone. Participants were reimbursed with AU\$60 at the conclusion of the interview.

Participants

Eligibility criteria included being male, aged 18 years or older, living in Sydney or the Blue Mountains for the last 6 months and having used AAS and/or performance and image enhancing drugs within the last 6 months. In total, 74 men completed the in-depth interview.

Measures

Social physique anxiety Individuals' self-reported anxiety about others' judgement of their physiques in social settings was measured using the seven-item version of the Social Physique Anxiety Scale (SPAS-7) [20], which is an adapted and improved version of the original 12-item Social Physique Anxiety Scale [21]. Example items include: 'When I look in the mirror I feel good about my physique/figure' and 'In the presence of others I feel apprehensive about my physique/figure'. The response format on the SPAS-7 is a five-point Likert-type scale with anchors at 1 (not at all characteristic of me) and 5 (extremely characteristic of me). Scores are summed to calculate an overall score that ranges from 7 to 35, with higher scores indicating greater social physique anxiety. The SPAS-7 demonstrates robust test-retest reliability ($r = 0.94$) [22] and internal consistency [20]. Internal consistency in the current study was adequate ($\alpha = 0.85$).

AAS dependence Severity of AAS dependence was measured using the five-item Severity of Dependence Scale (SDS) [23] adapted for AAS (SDS-AAS) [24]. Importantly, the SDS-AAS items are closely mapped to the tentative diagnostic criteria for steroid dependence proposed by Kanayama [25]. For example, the item 'How difficult did you find it to stop or go without anabolic steroids' is closely mapped to the criterion of withdrawal (criterion 2), the item 'Did you ever think your use of anabolic steroids was out of control' is closely mapped to the criterion of loss of control (criterion 3) and the item 'Did you wish you could stop using anabolic steroids' is closely mapped to the criterion of desiring to control or cut down one's steroid use (criterion 4). The response format of the SDS-AAS is a four-point Likert-type scale with anchors at 0 (never/almost never) and 3 (always/nearly always). The fifth and final item, 'How difficult did you find it to stop or go without anabolic steroids?' uses different response labels: 0 = not difficult, 4 = impossible. Scores are summed to calculate an overall score that ranges from 0 to 15, with higher scores indicating greater severity of AAS dependence. The psychometric properties of the SDS-AAS are less

clear than for other illicit drugs because the scholarly literature on AAS is considerably smaller [24]. Nevertheless, the SDS-AAS items appear to have strong content validity for AAS, and internal consistency in the current study was adequate ($\alpha = 0.75$).

Depression symptoms Symptoms of depression were measured using the depression module of the Patient Health Questionnaire [26]. Respondents are asked to indicate how often they have been bothered by various problems linked to depression during the past 2 weeks. Examples include 'Feeling tired or having little energy' and 'Little interest or pleasure in doing things'. The response format is a four-point Likert-type scale with anchors at 0 (not at all) and 3 (nearly every day). Scores are summed to calculate an overall score that ranges from 0 to 27, with higher scores indicating more severe depression symptoms. Scores higher than 10 are strongly predictive of an individual suffering from major depression [26]. Internal consistency in the current study was adequate ($\alpha = 0.74$).

Hazardous and risky drinking Hazardous and risky drinking was measured using the three-item Alcohol Use Disorders Identification Test—Consumption (AUDIT-C), which is a modified short-form of the 10-item Alcohol Use Disorders Identification Test [27]. Respondents are asked how often they consume drinks containing alcohol, how many standard drinks they consume during a typical day and how often they consume six or more drinks in a single occasion. The response format is a Likert-type scale with anchors at 0 and 4 (response labels differ for each item). Scores are summed to calculate an overall score that ranges from 0 to 12, with higher scores indicating riskier and more hazardous drinking.

Use of non-AAS illicit substances Participants were asked about their recent (12 months) use of non-AAS illicit substances, including cannabis, methamphetamine, crystal methamphetamine, cocaine, ecstasy, LSD and heroin. Endorsements were summed to create a variable representing the number of non-AAS illicit substances recently used by participants.

Side-effects due to AAS use Participants were asked about the occurrence of psychological side effects due to their AAS use. Psychological side-effects examined in the survey included impulsivity, sleeplessness, irritability, aggressiveness, relationship difficulties, fatigue/tiredness and paranoia. Occurrences were summed to create a variable representing the number of psychological side-effects experienced by participants.

Abnormal test results Participants were asked to indicate if they had received an abnormal test of liver or renal function, abnormal cholesterol levels or abnormal testosterone and oestrogen levels. Occurrences were summed to create a variable representing the overall number of abnormal test results.

Statistical analyses

Very little missing data were present, with the exception of data on the AUDIT-C. Missing data on the AUDIT-C were confined to 10 participants for whom no item-level AUDIT-C data were recorded at all. Participants for whom AUDIT-C data were missing did not differ in any significant way from participants who reported these data. Because hazardous and risky drinking was a primary variable of interest in the current study, it was decided to retain the variable in subsequent multivariate analyses, despite the consequent loss of power caused by its inclusion as a predictor in the multiple regression. In the interest of thoroughness, we subsequently conducted a regression with the AUDIT-C excluded as a predictor, and the results were unchanged, suggesting that this decision had little, if any, influence on the results.

Data distributions for several variables were positively skewed, including social physique anxiety, depression symptoms, AAS dependence symptoms, hazardous and risky drinking and number of abnormal test results. Spearman rank-order bivariate correlations were conducted in order to accommodate the preponderance of non-normality in the dataset.

Next, a simultaneous multivariate regression was conducted with social physique anxiety as the dependent variable and the following entered as predictor variables: depression symptoms, AAS dependence symptoms, hazardous and risky drinking, number of non-AAS illicit drugs used, number of psychological side-effects and number of abnormal test results. All predictors were mean-centred prior to entry. Each test assumption of multivariate regression was met, including normally distributed residuals, no evidence of non-linear relationships between the predictors and dependent variable, no evidence of multi-collinearity, and no evidence of heteroscedasticity. An *a priori* power analysis conducted using G*Power version 3.1 [28] indicated that the multiple regression was adequately powered to detect medium-to-large relationships between the predictor variables and the dependent variable using a conventional level of power ($\beta = 0.80$) and significance ($\alpha = 0.05$).

Importantly, one case was identified as a significant multivariate outlier (Malahnobis' distance $\chi^2 = 24.67$,

df = 6, $P < 0.001$) and this case was disproportionately influential on the results of the multivariate regression analysis (Cook's distance = 1.05; values ≥ 1.00 are indicative of disproportionate or undue influence) [18]. Therefore, the multivariate regression was conducted with the outlier removed and the summary statistics presented in Table 2 reflect this. In terms of significance testing, the relationship between social physique anxiety and AAS dependence severity was significant with the outlier excluded, but not when the outlier was included. The decision to exclude the outlier response was justified on the basis that the outlier was a clear and unequivocal outlier that exhibited a demonstrably disproportionate influence on the results of the regression. Further, we note that the relationship of AAS dependence with social physique anxiety became convincingly significant ($P = 0.001$) after the outlier was removed, as opposed to becoming only marginally significant.

Finally, in order to control the family-wise error rate at $\alpha = 0.05$, a Bonferroni-corrected α of 0.008 was used as the significance threshold for each individual predictor in the multiple regression analyses.

Results

Sample characteristics

The median age of participants was 29 years (interquartile range = 23–33 years). Approximately one-fifth of participants reported speaking a language other than English (20%), cultural background other than Anglo-Australian (22%), or country of birth other than Australia (16%). More than half of participants were full-time employed (59%), however almost one-third (30%) had a weekly income less than AU\$600.

Descriptive statistics

Descriptive statistics are shown in Table 1. Psychological side-effects reported by AAS users included impulsivity (56.7%), sleeplessness (54.1%), irritability (46.6%), aggressiveness (45.3%), relationship difficulties (38.4%), fatigue/tiredness (23.3%) and paranoia (16.3%).

Bivariate correlations

As shown in Table 1, AAS users who reported greater social physique anxiety also tended to report more severe symptoms of both depression and AAS dependence. In turn, depression and AAS dependence were positively correlated. Social physique anxiety was not correlated with hazardous and risky drinking, the number of non-AAS illicit substances used, the number of psychological side-effects due to AAS use or the number of abnormal test results. AAS dependence was positively correlated with the frequency of abnormal test results.

Multivariate regression

The regression model accounted for 46.0% of the variance in social physique anxiety scores, which was significant, $F(6, 53) = 7.53$, $P < 0.001$. As shown in Table 2, greater social physique anxiety among AAS users was uniquely associated with more severe symptoms of both depression and AAS dependence. The size of these associations, indexed by partial eta squared (η_p^2), was large. Social physique anxiety was not associated with hazardous and risky drinking, the number of non-AAS illicit substances used, the

Table 1. Descriptive statistics and Spearman rank-order bivariate correlations for the dependent and predictor variables included in the multivariate regression analysis

Variable	Observed range	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7
1 Social physique anxiety	7–32	14.85	6.15	—	0.49***	0.31**	–0.00	0.12	0.11	0.01
2 Depression symptoms	0–16	3.89	3.57	—	—	0.28*	–0.19	0.08	0.25*	0.04
3 Severity of AAS dependence	0–14	2.14	2.54	—	—	—	–0.09	0.05	0.37**	0.41***
4 Hazardous and risky drinking	1–10	3.89	2.35	—	—	—	—	0.30*	0.03	–0.16
5 Number of non-AAS illicit substances used	0–5	1.31	1.39	—	—	—	—	—	0.25*	–0.01
6 Number of psychological side-effects	0–7	2.81	1.71	—	—	—	—	—	—	0.27*
7 Number of abnormal test results	0–6	0.61	1.29	—	—	—	—	—	—	—

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$. AAS, anabolic–androgenic steroids.

Table 2. Summary statistics from the simultaneous multivariate regression predicting social physique anxiety among anabolic–androgenic steroids (AAS) users

Variable	<i>b</i>	SE <i>b</i>	β	95% CI	<i>t</i> (53)	<i>P</i>	η_p^2 ^a
Depression symptoms	0.82	0.19	0.48	0.44, 1.19	4.36	<0.001 ^b	0.26
Severity of AAS dependence	1.19	0.35	0.40	0.50, 1.88	3.46	0.001 ^b	0.18
Hazardous and risky drinking	0.17	0.31	0.06	−0.45, 0.80	0.55	0.583	<0.01
Number of non-AAS illicit substances used	−0.21	0.51	−0.05	−1.23, 0.82	−0.40	0.690	<0.01
Number of psychological side effects	−0.19	0.42	−0.05	−1.04, 0.66	−0.44	0.662	<0.01
Number of abnormal test results	0.55	0.51	0.12	−0.47, 1.57	1.08	0.284	0.02

^aThe effect size given here is partial eta squared (η_p^2) (small = 0.01, medium = 0.06, large = 0.14). ^bStatistically significant when compared against a Bonferroni corrected α of 0.008. AAS, anabolic–androgenic steroids; CI, confidence interval.

number of psychological side-effects due to AAS use, or the number of abnormal test results.

Discussion

This study aimed to determine whether, and to what extent, social physique anxiety was associated with indicators of psychological dysfunction among AAS users. The results from the multivariate regression analysis provided partial support for the hypothesis of the study, namely, that AAS users who experience greater social physique anxiety would report greater severity of AAS dependence and depression, more hazardous and risky drinking, more frequent use of non-AAS illicit substances, more frequent psychological side effects due to AAS use and more frequent abnormal test results due to AAS use. The results showed that greater social physique anxiety among AAS users was uniquely associated with more severe symptoms of both depression and AAS dependence, but not with hazardous and risky drinking, non-AAS illicit substance use, psychological side-effects due to AAS use, or abnormal test results.

The finding that greater social physique anxiety is associated with more severe symptoms of AAS dependence is compelling and consistent with previous research. Two studies are instructive. First, research conducted by Cole *et al.* [24] found that symptoms of AAS dependence were highly correlated ($r = 0.58$) with eating disorder symptoms among AAS users. Second, research conducted by Murray *et al.* [6] found that AAS users who reported an appearance motivation for their AAS use exhibited markedly more severe eating disorder and muscle dysmorphia psychopathology than users who reported either a performance motivation or a blended motivation of both appearance and performance. Consistent with the hypothesis that AAS users motivated by appearance are at greater risk for harm than users motivated by other factors, we

hypothesise that appearance users are more susceptible to a core nexus of psychopathology involving body image, dieting and exercise. In turn, this psychopathology facilitates the development and/or maintenance of a syndrome of AAS dependence [25,29–31]. In line with this hypothesis, we note the strong relationship of social physique anxiety with AAS dependence that emerged in the current study ($\eta_p^2 = 0.18$).

In addition, the core nexus of psychopathology associated with AAS users motivated by appearance concerns may also include mood disturbance, and in particular, depression. Indeed, the relationship observed in the current study between social physique anxiety and depression symptoms ($\eta_p^2 = 0.26$) was stronger than the relationship observed for AAS dependence symptoms. Several studies of AAS users have reported elevated rates of depression, and of dysphoric mood more generally, among this population (e.g. [32]). In addition, studies of men with muscle dysmorphia—a subtype of body dysmorphic disorder akin to (and formerly named) ‘reverse anorexia’—report elevated rates of comorbid mood disorders. In two studies by Cafri *et al.* [33] and Olivardia *et al.* [34], the prevalence of a lifetime history of either depression or bipolar disorder was some 58–74% among individuals with muscle dysmorphia, and just 3–7% among healthy gym-attending controls. These studies of muscle dysmorphia are relevant because 40–54% of individuals with muscle dysmorphia report using AAS [33–35], and nearly one in four (21%) exhibit AAS abuse or dependence [36].

Limitations of the study are noted. First and foremost, the measure of AAS dependence, the SDS-AAS, has not been validated to the same extent as for other substances, warranting caution in the interpretation of these data. Additional psychometric testing of the SDS-AAS and of complementary measures of steroid dependence (e.g. [37]) is a critical direction for future research. Second, high levels of social physique anxiety do not necessarily indicate an appearance-linked motivation for AAS use. Third, the study design was cross-sectional,

precluding statements regarding the direction of causality. Fourth, socially desirable responding may have suppressed true reporting of social physique anxiety (and psychopathology more generally) because traditional notions of masculinity are incompatible with emotional weakness and expressions of this nature [38]—a limitation made salient by research indicating that AAS users are stronger adherents to traditional male gender roles than non-users [39]. Fifth, it would have been useful to collect data about our participants' past and present engagement in athletic and bodybuilding competitions, including whether they used AAS in these competitions. Further, it would have been useful to collect data about participants' past and present employment, including, in particular, occupations that previous research has linked with AAS use (e.g. Ref. [13]).

In conclusion, the current study aimed to determine whether AAS users who experience physical appearance concerns are at greater risk for psychological dysfunction. Our results indicate this appears to be the case. Specifically, AAS users who are motivated by appearance concerns may also be at higher risk of both AAS dependence and depression—an important finding that warrants additional research.

Acknowledgements

SG is supported by an National Health and Medical Research Council (NHMRC) Early Career Fellowship (1121538). BL and LD are supported by National Health and Medical Research Council Research Fellowships (Nos. 1041472 and 1073858). The National Drug and Alcohol Research Centre at UNSW Australia is supported by funding from the Australian Government under the Substance Misuse Prevention and Service Improvements Grant Fund. The funders had no role in the design, execution or reporting of the study. No additional funding sources are declared. The authors thank the study participants for their contribution to the research, current and past researchers and staff, with particular thanks to Ranira Moodley and Janelle Holden.

References

- [1] Memedovic S, Iversen J, Geddes L, Maher L. Australian Needle Syringe Program Survey National Data Report 2011–2015: prevalence of HIV, HCV and injecting and sexual behaviour among NSP attendees. Kirby Institute, University of New South Wales, 2016.
- [2] Sagoe D, Molde H, Andreassen CS, Torsheim T, Pallesen S. The global epidemiology of anabolic-androgenic steroid use: a meta-analysis and meta-regression analysis. *Ann Epidemiol* 2014;24:383–98.
- [3] Cohen J, Collins R, Darkes J, Gwartzney DA. League of their own: demographics, motivations and patterns of use of 1,955 male adult non-medical anabolic steroid users in the United States. *J Int Soc Sports Nutr* 2006;4:12.
- [4] Hildebrandt T, Alfano L, Langenbucher JW. Body image disturbance in 1000 male appearance and performance enhancing drug users. *J Psychiatr Res* 2010;44:841–6.
- [5] Ip EJ, Barnett MJ, Tenerowicz MJ, Perry PJ. The anabolic 500 survey: characteristics of male users versus nonusers of anabolic-androgenic steroids for strength training. *Pharmacotherapy* 2011;31:757–66.
- [6] Murray SB, Griffiths S, Mond JM, Kean J, Blashill AJ. Anabolic steroid use and body image psychopathology in men: delineating between appearance- versus performance-driven motivations. *Drug Alcohol Depend* 2016;165:198–202.
- [7] Cafri G, Thompson JK, Ricciardelli L, McCabe M, Smolak L, Yesalis C. Pursuit of the muscular ideal: physical and psychological consequences and putative risk factors. *Clin Psychol Rev* 2005;25:215–39.
- [8] Rohman L. The relationship between anabolic androgenic steroids and muscle dysmorphia: a review. *Eat Disord* 2009;17:187–99.
- [9] Pope HG, Kanayama G, Hudson JI. Risk factors for illicit anabolic-androgenic steroid use in male weightlifters: a cross-sectional cohort study. *Biol Psychiatry* 2012;71:254–61.
- [10] Kimergård A. A qualitative study of anabolic steroid use amongst gym users in the United Kingdom: motives, beliefs and experiences. *J Subst Use* 2015;20:288–94.
- [11] Hanley Santos G, Coomber R. The risk environment of anabolic-androgenic steroid users in the UK: examining motivations, practices and accounts of use. *Int J Drug Policy* 2017;40:35–43.
- [12] Sagoe D, Andreassen C, Pallesen S. The aetiology and trajectory of anabolic-androgenic steroid use initiation: a systematic review and synthesis of qualitative research. *Subst Abuse Treat Prev Policy* 2014;9:27.
- [13] Hoberman J. *Dopers in uniform*. Austin, TX: University of Texas Press, 2017.
- [14] Kanayama G, Pope HG Jr. History and epidemiology of anabolic androgens in athletes and non-athletes. *Mol Cell Endocrinol* 2017 [Epub ahead of print].
- [15] Ravn S, Coffey J. 'Steroids, it's so much an identity thing!' Perceptions of steroid use, risk and masculine body image. *J Youth Stud* 2015;19:87–102.
- [16] Griffiths S, Murray SB, Dunn M, Blashill AJ. Anabolic steroid use among gay and bisexual men living in Australia and New Zealand: associations with demographics, body dissatisfaction, eating disorder psychopathology, and quality of life. *Drug Alcohol Depend* 2017;181:170–6.
- [17] Underwood M. Exploring the social lives of image and performance enhancing drugs: an online ethnography of the Zyzz fandom of recreational bodybuilders. *Int J Drug Policy* 2017;39:78–85.
- [18] Griffiths S, Hay P, Mitchison D *et al*. Sex differences in the relationships between body dissatisfaction, quality of life and psychological distress. *Aust N Z J Public Health* 2016;40:518–22.
- [19] Mitchison D, Hay P, Slewa-Younan S, Mond J. The changing demographic profile of eating disorder behaviors in the community. *BMC Public Health* 2014;14:943.
- [20] Motl RW, Conroy DE, Horan PM. The social physique anxiety scale: an example of the potential consequence of negatively worded items in factorial validity studies. *J Appl Meas* 2000;1:327–45.
- [21] Hart EA, Leary MR, Rejeski WJ. The measurement of social physique anxiety. *J Sport Exerc Psychol* 1989;11:94–104.
- [22] Scott LA, Burke KL, Joyner AB, Brand JS. Examining the stability of the 7-item social physique anxiety scale using a test-retest method. *Meas Phys Educ Exerc Sci* 2009;8:57–62.
- [23] Gossop M, Darke S, Griffiths P *et al*. The severity of dependence scale (SDS): psychometric properties of the SDS in English and Australian samples of heroin, cocaine and amphetamine users. *Addiction* 1995;90:607–14.
- [24] Cole JC, Smith R, Halford JCG, Wagstaff GF. A preliminary investigation into the relationship between anabolic-androgenic steroid use and the symptoms of reverse anorexia in both current and ex-users. *Psychopharmacology* 2003;166:424–9.
- [25] Kanayama G, Brower KJ, Wood RI, Hudson JI, Pope HG Jr. Anabolic-androgenic steroid dependence: an emerging disorder. *Addiction* 2009;104:1966–78.
- [26] Kroenke K, Spitzer RL, Williams JBW. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med* 2001;16:606–13.
- [27] Bush K, Kivlahan DR, McDonnell MB, Fihn SD, Bradley KA. The AUDIT alcohol consumption questions (AUDIT-C). *Arch Intern Med* 1998;158:1789–95.

- [28] Faul F, Erdfelder E, Buchner A, Lang A-G. Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behav Res Methods* 2009;41:1149–60.
- [29] Kanayama G, Brower KJ, Wood RI, Hudson JI, Pope HG Jr. Treatment of anabolic-androgenic steroid dependence: emerging evidence and its implications. *Drug Alcohol Depend* 2010;109:6–13.
- [30] Hildebrandt T, Lai JK, Langenbucher JW. The diagnostic dilemma of pathological appearance and performance enhancing drug use. *Drug Alcohol Depend* 2011;114:1–11.
- [31] Pope HG Jr, Khalsa JH, Bhasin S. Body image disorders and abuse of anabolic-androgenic steroids among men. *JAMA* 2017;317:23–4.
- [32] Hildebrandt T, Langenbucher JW, Carr SJ, Sanjuan P. Modeling population heterogeneity in appearance- and performance-enhancing drug (APED) use: applications of mixture modeling in 400 regular APED users. *J Abnorm Psychol* 2007;116:717–33.
- [33] Cafri G, Olivardia R, Thompson JK. Symptom characteristics and psychiatric comorbidity among males with muscle dysmorphia. *Compr Psychiatry* 2008;49:374–9.
- [34] Olivardia R, Pope HG, Hudson J. Muscle dysmorphia in male weightlifters: a case-control study. *Am J Psychiatry* 2000;157:1291–6.
- [35] Hitzeroth V, Wessels C, Zungu Dirwayi N, Oosthuizen P, Stein DJ. Muscle dysmorphia: a south African sample. *Psychiatry Clin Neurosci* 2001;55:521–3.
- [36] Pope CG, Pope HG, Menard W, Fay C, Olivardia R, Phillips KA. Clinical features of muscle dysmorphia among males with body dysmorphic disorder. *Body Image* 2005;2:395–400.
- [37] Pope HG, Kean J, Nash A *et al*. A diagnostic interview module for anabolic-androgenic steroid dependence: preliminary evidence of reliability and validity. *Exp Clin Psychopharmacol* 2010;18:203–13.
- [38] Griffiths S, Murray SB, Touyz S. Extending the masculinity hypothesis: an investigation of gender role conformity, body dissatisfaction, and disordered eating in young heterosexual men. *Psychol Men Masculinity* 2015;16:108–14.
- [39] Kanayama G, Barry S, Hudson JI, Pope HG. Body image and attitudes toward male roles in anabolic-androgenic steroid users. *Am J Psychiatry* 2006;163:697–703.