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Mood Symptoms in Steroid Users: The Unexamined Role of Concurrent Stimulant Use

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INTRODUCTION

Appearance and performance enhancing drugs (APEDs) include a range of illicit, prescription, and over-the-counter preparations used to increase lean body-mass in order to attain idealized physiques and improve athletic performance (Thomas Hildebrandt, Langenbucher, Carr, & Sanjuan, 2007). Most APED users are polydrug users engaging in “stacking,” taking several drugs from different categories concurrently and sequentially over 8-10 week time blocks (Dodge & Hoagland, 2011). This study focuses on two APED categories: Anabolic-Androgenic Steroids (referred to simply as “steroids” in this article) and Thermogenic and Ergogenic Drugs (stimulants). Substances in the steroids group include numerous synthetic testosterone derivatives varying in half-lives and metabolite ratios. Stimulants used in this capacity include fat-burning and energy-boosting drugs (Coffey, Steiner, Baker, & Allison, 2004; Maglione et al., 2005; Shekelle PG, Hardy ML, Morton SC, & et al, 2003; Sjöqvist, Garle, & Rane, 2008). Common stimulants include liothyronine (thyroid hormone), clenbuterol (illicit in the U.S.), synephrine, ephedra, ephedrine, theophylline, and caffeine (Thomas Hildebrandt, Harty, & Langenbucher, 2012; Thomas Hildebrandt et al., 2007). When used as medically indicated, these stimulants have less dramatic mood effects than stimulants better associated with misuse (e.g. methamphetamine.)

Prevalence

Prevalence rates of steroid use range from 1.5% of 12th graders (Johnston, O’Malley, Bachman, & Schulenberg, 2012), 6.4% of adult males, 13.4% of athletes, to 18.4% among recreational sports people (Sagoe, Molde, Andreassen, Torsheim, & Pallesen, 2014). The prevalence of APED stimulant use is more complicated as these include common substances

(e.g. caffeine) as well as prescription-only medications. Rates of stimulant use are higher among athletes using of other types of APEDs (Buckman, Farris, & Yusko, 2013) ranging from 28% to 56% compared to non-APED users. Other research has found rates ranging from 25% for ephedrine (Kanayama, Gruber, Pope, Jr., Borowiecki, & Hudson, 2001) to 58% for ephedrine, pseudoephedrine, or amphetamine (Bents, Tokish, & Goldberg, 2004) among athletes and 7% for non-prescription weight loss products in the general population (Blanck H, Khan L, & Serdula MK, 2001).

Mood Effects

There is widespread popular belief that the use of steroids routinely results in powerful episodes of anger and violence termed “roid rage” (Chantal, Soubranne, & Brunel, 2009). However, researchers in this field agree that such negative mood effects are more likely to be rare and difficult to predict (Thomas Hildebrandt et al., 2007; Kanayama, Hudson, & Pope, 2009; Pope HG, Jr, Kouri EM, & Hudson JI, 2000; Rubinow & Schmidt, 1996; Yates, Perry, MacIndoe, Holman, & Ellingrod, 1999). Prior research has found adverse psychological effects of steroids including anger, aggressiveness, depression, and mania (Daly et al., 2003; Pagonis, Angelopoulos, Koukoulis, & Hadjichristodoulou, 2006; Su T et al., 1993; Yates, Perry, & Murray, 1992). Positive effects may include enhanced self-esteem, vigor, libido, perceived power, and concentration (Tom Hildebrandt, Langenbucher, Carr, Sanjuan, & Park, 2006). However, many studies have failed to find any psychoactive effects associated with steroid use (Bagatell, Heiman, Matsumoto, Rivier, & Bremner, 1994; Bahrke, Wright, Strauss, & Catlin, 1992; Malone, Dimeff, Lombardo, & Sample, 1995; Midgley, Heather, & Davies, 2001; O’Connor, Archer, & Wu, 2004; Tricker et al., 1996; Yates et al., 1999), supporting the idea that steroid mood effects are idiosyncratic. An understanding of the variables associated with APED-related mood disturbance is critical for identifying high risk individuals and for developing treatments. Most research on APED-induced mood effects focuses solely on steroids and does not examine concurrently used drugs (e.g. stimulants).

This study was designed to assess the effects of stimulant use on mood effects as a potential variable underlying the idiosyncratic nature of steroid-associated negative mood effects. We also tried to minimize retrospective memory errors by only assessing current mood. In accordance with research finding mood effects associated with steroid use, we hypothesized that current steroid and stimulant use each would be associated with (1) increased vigor, mania, anxiety, depression, anger, fatigue, and confusion and (2) decreased positive affect.

METHODS

Links from internet websites that primarily focused on bodybuilding, weightlifting, or using steroids, and also from search engines, led to our internet-accessible survey, which was located on the Rutgers University website. These links were identified as leading to a “Rutgers survey on training practices and mood.” All participants initially followed this link to a Rutgers Institutional Review Board-approved consent form and clicked on second link at the bottom of this page to indicate consent. The entire protocol of the study was approved by the Rutgers Institutional Review Board.

Participants

Participants were 122 male weightlifters and bodybuilders, mean age of 32 (19-57, $SD = 8.68$), who anonymously followed the consent link. Females were targeted as well as males, but only males reached a sample size that could be analyzed. Participants did not need to have used APEDs to enroll, but, because the survey was linked to some websites with steroid-related content, many had used them. Participants did not receive any financial compensation for completing the survey. Eight participants who completed the survey were excluded for missing data. There were no other exclusion criteria.

Measures

The questionnaire began with demographic questions and then presented the following mood scales, each adapted to query the past 24-hours. Participants rated current moods prior to reporting current drug use. Questions about weight-training were interwoven between mood questionnaires.

Anger—The Revised State-Trait Anger Expression Inventory (STAXI-2; Spielberger, 1998) State-Anger scale assesses the intensity of anger at a particular time, and has been used extensively in research on health and anger. It has 3 subscales: Feelings, Verbal, and Physical.

Mania—The Self-Report Manic Inventory (SRMI; Shugar, Schertzer, Toner, & di Gasbarro, 1992) has been found more sensitive than other measures to euthymic and hypomanic fluctuations (Cooke, Krüger, & Shugar, 1996).

Mood—The Profile of Mood States – Brief (POMS-B; McNair & Heuchert, 2005), the only authorized short version of the POMS, has six factors: tension/anxiety, depression/dejection, anger/hostility, vigor/activity, fatigue/inertia, and confusion/bewilderment.

Positive Mood—The Automatic Thoughts Questionnaire – Positive (ATQ-P; Ingram & Wisnicki, 1988), measures the occurrence of positive self-relevant cognitions.

The Marlowe-Crowne Social Desirability Scale (M-CSDS; Crowne & Marlowe, 1960) and the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) were included as covariates, to control for the desire to look good and trait affect.

Mood scales were followed by sections developed specifically for this study assessing current steroid and stimulant use, dietary and sleep habits, use of other medications, and prior physical or psychiatric diagnoses. The entry question to the steroids section was, “Have you ever used anabolic steroids?” For participants who answered “yes,” this was followed by further questions about specific drugs used and patterns of use. The entry question to the stimulants section was “Have you ever used fat burners or endurance boosters such as Xenadrine or T3?” For participants answering “yes,” this was again followed by further questions about drugs and patterns of use.

Data Analysis

The main goal was to identify mood effects associated with steroids and stimulants. Because steroids have a long half-life and most stimulants have a comparatively short half-life, participants were considered currently on steroids if they had used them in the past 14 days and as currently on stimulants if they had used them in the past 24 hours. Analyses consisted of 2×2 analyses of covariance (ANCOVA) for drug use status (current steroid by current stimulant) for each mood scale. We controlled for social desirability, trait affect, age, marital status, employment, income, exercise recency, and prior night's sleep. In addition, effect sizes were examined (Cohen's d) for steroid and stimulant use on mood as compared to normative population scores for the POMS-B (Yeun & Shin-Park, 2006), ATQ (Ingram, Kendall, Siegle, Guarino, & McLaughlin, 1995), and STAXI (Spielberger, 1998).

RESULTS

Demographics

Of 236 individuals who clicked the survey link, 225 consented, 135 completed the survey, 130 were male, and 122 had complete data for these analyses. Eight-four percent of participants resided in the United States, 45% were married, 75% were employed full-time, 40% had a college degree, and another 16% held graduate degrees. The majority of the participants were Caucasian (93%). Sixty-two percent of participants identified their training goal as a bodybuilding, while 36% identified it as weight-lifting. Participants averaged 97 ($SD = 14.3$, Range = 63-141) kilograms with a body mass index of 30 ($SD = 3.8$, Range 22-44) and fat-free mass index (FFMI – determined by height, weight, and self-reported body fat percentage (Kouri et al., 1995b) of 25 ($SD = 3.2$, Range 18-36). They were experienced APED users: 87% ($N=106$) reporting lifetime use of steroids for an average 3.6 years ($SD = 4.28$) and 80% ($N=97$) reporting lifetime use of stimulants for an average 3.5 years ($SD = 4.1$). Thirty-one percent ($N=38$) of the sample was not currently taking steroids or stimulants, 30% ($N=37$) were currently taking only steroids, 18% ($N=22$) were currently taking only stimulants, and 21% ($N=25$) were currently taking both steroids and stimulants.

Internal Consistency—Internal consistency for the measures in our sample was good and ranged from 0.77 to 0.94 as follows, for the STAXI-2: $\alpha=0.94$, SRMI: $\alpha=0.85$, POMS: $\alpha=0.90$, ATQ-P: $\alpha=0.94$, M-CSDS: $\alpha=0.77$ and PANAS: $\alpha=0.83$.

ANCOVAs

The overall F-tests for all ANCOVA models were significant ($p<.001$), with significant main effects ($p<.025$) for stimulant use on Tension/Anxiety and for steroid use on Vigor/Activity. Participants using stimulants scored higher on Tension/Anxiety than those not using stimulants and participants using steroids scored lower on Vigor/Activity than non-users. No interaction effects were found for stimulants by steroids, but these were included in the models in Table 1.

Effect Size Analyses

Cohen's d was calculated to examine effect sizes for differences between mood means for the APED-using subsample (steroid or stimulant use) and normal populations (Ingram et al.,

1995; Spielberger, 1998; Yeun & Shin-Park, 2006). The APED-using subsample in this study had significantly lower scores (Table 1: last column) than norms for all POMS-B negative mood scales, higher than normal ATQ-P positive affect scores, and were not different than norms for vigor/activity or any STAXI anger scales. The magnitudes of the differences in effect size between the APED users and the general population were not different across POMS-B mood subscales, $Q(5)=.021$, $p>.99$, nor anger (STAXI) subscales, $Q(2)=2.99$, $p=.23$. The grand mean effect size for POMS-B mood was .54, indicating that the APED-using subsample was on average a half standard deviation below the normal population on measures of mood disturbance. For the anger (STAXI) scales the grand mean effect size was .07, thus not different than the general population.

DISCUSSION

Steroid users reported less vigor/activity than non-users, and stimulant users reported higher levels of tension/anxiety compared to non-users. Otherwise, for most mood measures there were no differences between steroid and/or stimulant users and non-users. These findings support the idea that mood effects of steroids are idiosyncratic and not commonplace. Results are consistent with previous research that has also failed to find steroid specific effects (Bagatell et al., 1994; Bahrke et al., 1992; Malone et al., 1995; Midgley et al., 2001; O'Connor et al., 2004; Pope HG et al., 2000; Tricker et al., 1996; Yates et al., 1999). The effect of stimulant use on tension/anxiety was consistent with the central nervous system arousal side-effect profiles of these substances (Maglione et al., 2005; Pearce & Himsworth, 1982; Shekelle PG et al., 2003). The higher tension/anxiety in stimulant users may account for some prior reports of mood disturbance in steroid users.

Also supporting the idiosyncratic nature of negative APED mood effects, the APED-using subsample scored in normal or below normal ranges on the mood and anger subscales. Indeed, APED users scored lower on all negative mood scales and higher on positive thoughts than the normative samples, but no differently than the norm for anger. It is possible that characteristics of these athletes (e.g. consistent exercise and dietary regimens, goal-directed motivation) were protective against adverse moods.

Limitations and Strengths

The sample demographics may not be representative of the bodybuilding/weightlifting population, though consistent with previous research in this area. If some subsample of APED users were more likely to experience anger or aggression with APEDs, (e.g. inmates, violent criminals) they may have been missed by web-based recruitment. Additionally, dose was not assessed and the sample was not large enough to sort out mood effects associated with different types of steroids/stimulants. Finally, the entry question for the stimulants section only gave two examples (Xenadrine and T3) in addition to specifying “fat burners and endurance boosters”, and some people may have been using other substances that would fall under this category, but not have thought they applied here if they were not listed as examples. Additionally, we included many preparations in this section that contain high doses of caffeine, but there may have been other ways not on our list in which participants were using high dose caffeine.

By utilizing internet technology to assess bodybuilders and weightlifters anonymously about current APED use and mood state this study builds upon prior self-report research that queried over longer retrospective recall periods (Choi & Pope, 1994; Cooper, Noakes, Dunne, Lambert, & Rochford, 1996; Lefavi, Reeve, & Newland, 1990; Parrott, Choi, & Davies, 1994; Pope & Katz, 1988, 1994) as well as other APED research (Choi, Parrott, & Cowan, 1990; Kouri, Lukas, Pope, & Oliva, 1995; Moss, Panzak, & Tarter, 1992; Perry et al., 2003). This prior research was by necessity limited by the error inherent in longer retrospective recall periods. Additionally, we were able to assess participants from across the United States and around the world, and thus our results do not reflect only local trends. And finally, we were able to recruit participants who might have been unwilling or unable to visit a laboratory setting for face-to-face assessment.

Conclusions

This study was designed to examine the role of stimulants used in addition to steroids among bodybuilders and weightlifters utilizing a current use and current mood focused cross-sectional internet-based survey of bodybuilders and weightlifters. No adverse mood effects were significantly associated with steroid use, while anxiety/tension was significantly associated with stimulant use. The findings from this study regarding stimulant use suggest these substances are not benign. Their use with steroids may account for some adverse moods, particularly increased anxiety and tension, often associated with steroids. Future natural observation research on steroid mood effects needs to assess and control for stimulant use among APED users. The roles of each of these classes of stimulants in mood changes should be differentiated. Physicians and mental health professionals might also take care to assess the use and psychoactive effects of stimulants in patients having potential APED-related problems. Idiosyncratic negative effects of APEDs on mood may be associated more with stimulant use than with steroid use, despite the congressional and general public focus on steroids in the United States.

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References

- Bagatell CJ, Heiman JR, Matsumoto AM, Rivier JE, Bremner WJ. Metabolic and behavioral effects of high-dose, exogenous testosterone in healthy men. *The Journal of Clinical Endocrinology & Metabolism*. 1994; 79(2):561–567. doi:10.1210/jcem.79.2.8045977. [PubMed: 8045977]
- Bahrke MS, Wright JE, Strauss RH, Catlin DH. Psychological moods and subjectively perceived behavioral and somatic changes accompanying anabolic-androgenic steroid use. *The American Journal of Sports Medicine*. 1992; 20(6):717–724. doi:10.1177/036354659202000613. [PubMed: 1456366]
- Bents RT, Tokish JM, Goldberg L. Ephedrine, pseudoephedrine, and amphetamine prevalence in college hockey players: most report performance-enhancing use. *The Physician and Sports Medicine*. 2004; 32:30–4. doi:10.3810/psm.2004.09.551.
- Blanck H, Khan L, Serdula MK. Use of nonprescription weight loss products: Results from a multistate survey. *JAMA*. 2001; 286(8):930–935. doi:10.1001/jama.286.8.930. [PubMed: 11509057]

- Buckman JF, Farris SG, Yusko DA. A national study of substance use behaviors among NCAA male athletes who use banned performance enhancing substances. *Drug and Alcohol Dependence*. 2013; 131(1–2):50–55. doi:10.1016/j.drugalcdep.2013.04.023. [PubMed: 23688842]
- Chantal Y, Soubranne R, Brunel PC. Exploring the social image of anabolic steroids users through motivation, sportspersonship orientations and aggression. *Scandinavian Journal of Medicine & Science in Sports*. 2009; 19(2):228–234. doi:10.1111/j.1600-0838.2007.00764.x. [PubMed: 18266791]
- Choi PY, Parrott AC, Cowan D. High-dose anabolic steroids in strength athletes: Effects upon hostility and aggression. *Human Psychopharmacology: Clinical and Experimental*. 1990; 5:349–356. doi: 10.1002/hup.470050407.
- Choi PY, Pope HG. Violence toward women and illicit androgenic-anabolic steroid use. *Annals of Clinical Psychiatry*. 1994; 6:21–5. doi:10.3109/10401239409148835. [PubMed: 7951641]
- Coffey CS, Steiner D, Baker BA, Allison DB. A randomized double-blind placebo-controlled clinical trial of a product containing ephedrine, caffeine, and other ingredients from herbal sources for treatment of overweight and obesity in the absence of lifestyle treatment. *International Journal of Obesity*. 2004; 28(11):1411–1419. doi:10.1038/sj.ijo.0802784. [PubMed: 15356670]
- Cooke RG, Krüger S, Shugar G. Comparative evaluation of two self-report mania rating scales. *Biological Psychiatry*. 1996; 40:279–283. doi:10.1016/0006-3223(95)00392-4. [PubMed: 8871774]
- Cooper CJ, Noakes TD, Dunne T, Lambert MI, Rochford K. A high prevalence of abnormal personality traits in chronic users of anabolic-androgenic steroids. *British Journal of Sports Medicine*. 1996; 30(3):246–250. doi:10.1136/bjism.30.3.246. [PubMed: 8889121]
- Crowne DP, Marlowe D. A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology*. 1960; 24:349–354. doi:10.1037/h0047358. [PubMed: 13813058]
- Daly RC, Su TP, Schmidt PJ, Pagliaro M, Pickar D, Rubinow DR. Neuroendocrine and behavioral effects of high-dose anabolic steroid administration in male normal volunteers. *Psychoneuroendocrinology*. 2003; 28:317–331. doi:10.1016/s0306-4530(02)00025-2. [PubMed: 12573299]
- Dodge T, Hoagland MF. The use of anabolic androgenic steroids and polypharmacy: A review of the literature. *Drug and Alcohol Dependence*. 2011; 114(2–3):100–109. doi:10.1016/j.drugalcdep.2010.11.011. [PubMed: 21232881]
- Hildebrandt T, Harty S, Langenbucher JW. Fitness supplements as a gateway substance for anabolic-androgenic steroid use. *Psychology of Addictive Behaviors*. 2012; 26(4):955–962. doi:10.1037/a0027877. [PubMed: 22486333]
- Hildebrandt T, Langenbucher J, Carr S, Sanjuan P, Park S. Predicting intentions for long-term anabolic-androgenic steroid use among men: A covariance structure model. *Psychology of Addictive Behaviors*. 2006; 20(3):234–240. doi:10.1037/0893-164X.20.3.234. [PubMed: 16938061]
- 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. *Journal of Abnormal Psychology*. 2007; 116(4):717–733. doi: 10.1037/0021-843X.116.4.717. [PubMed: 18020718]
- Ingram RE, Kendall PC, Siegle G, Guarino J, McLaughlin SC. Psychometric properties of the Positive Automatic Thoughts Questionnaire. *Psychological Assessment*. 1995; 7:495–507. doi: 10.1037/1040-3590.7.4.495.
- Ingram RE, Wisnicki KS. Assessment of positive automatic cognition. *Journal of Consulting and Clinical Psychology*. 1988; 56:898–902. doi:10.1037/0022-006x.56.6.898. [PubMed: 3204200]
- Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future national results on adolescent drug use: Overview of key findings, 2011. Institute for Social Research, The University of Michigan; Ann Arbor, MI: 2012.
- Kanayama G, Gruber AJ, Pope HG Jr, Borowiecki JJ, Hudson JI. Over-the-Counter Drug Use in Gymnasiums: An Underrecognized Substance Abuse Problem? *Psychotherapy and Psychosomatics*. 2001; 70(3):137–140. doi:10.1159/000056238. [PubMed: 11340414]

- Kanayama G, Hudson JI, Pope HG. Illicit anabolic-androgenic steroid use. *Hormones and Behavior*. 2009; 58:111–121. doi:10.1016/j.yhbeh.2009.09.006. [PubMed: 19769977]
- Kouri EM, Lukas SE, Pope HG, Oliva PS. Increased aggressive responding in male volunteers following the administration of gradually increasing doses of testosterone cypionate. *Drug and Alcohol Dependence*. 1995; 40:73–79. doi:10.1016/0376-8716(95)01192-7. [PubMed: 8746927]
- Kouri EM, Pope HG, Katz DL, Oliva P. Fat-free mass index in users and nonusers of anabolic-androgenic steroids. *Clinical Journal of Sport Medicine*. 1995; 5:223–8. [PubMed: 7496846]
- Lefavi RG, Reeve TG, Newland MC. Relationship between anabolic steroid use and selected psychological parameters in male bodybuilders. *Journal of Sport Behavior*. 1990; 13:157–166.
- Maglione M, Miotto K, Iguchi M, Jungvig L, Morton SC, Shekelle PG. Psychiatric Effects of Ephedra Use: An Analysis of Food and Drug Administration Reports of Adverse Events. *The American Journal of Psychiatry*. 2005; 162:189–191. doi:10.1176/appi.ajp.162.1.189. [PubMed: 15625222]
- Malone DA, Dimeff RJ, Lombardo JA, Sample RH. Psychiatric effects and psychoactive substance use in anabolic-androgenic steroid users. *Clinical Journal of Sport Medicine*. 1995; 5:25–31. [PubMed: 7614077]
- McNair, DM.; Heuchert, JWP. Profile of Mood States: Technical update. Multi-Health Systems, Inc.; North Tonawanda, NY: 2005.
- Midgley SJ, Heather N, Davies JB. Levels of Aggression among a Group of Anabolic-Androgenic Steroid Users. *Medicine, Science and the Law*. 2001; 41(4):309–314. doi:10.1177/002580240104100407.
- Moss HB, Panzak GL, Tarter RE. Personality, mood, and psychiatric symptoms among anabolic steroid users. *The American Journal on Addictions*. 1992; 1:315–324. doi:10.3109/10550499208993151.
- O'Connor DB, Archer J, Wu FCW. Effects of Testosterone on Mood, Aggression, and Sexual Behavior in Young Men: A Double-Blind, Placebo-Controlled, Cross-Over Study. *The Journal of Clinical Endocrinology & Metabolism*. 2004; 89(6):2837–2845. doi:10.1210/jc.2003-031354. [PubMed: 15181066]
- Pagonis TA, Angelopoulos NV, Koukoulis GN, Hadjichristodoulou CS. Psychiatric side effects induced by supraphysiological doses of combinations of anabolic steroids correlate to the severity of abuse. *European Psychiatry*. 2006; 21(8):551–562. doi:10.1016/j.eurpsy.2005.09.001. [PubMed: 16356691]
- Parrott AC, Choi PY, Davies M. Anabolic steroid use by amateur athletes: effects upon psychological mood states. *The Journal of Sports Medicine and Physical Fitness*. 1994; 34:292–8. [PubMed: 7830394]
- Pearce CJ, Himsworth RL. Thyrotoxicosis factitia. *The New England Journal of Medicine*. 1982; 307:1708–9. [PubMed: 7144872]
- Perry PJ, Kutscher EC, Lund BC, Yates WR, Holman TL, Demers L. Measures of aggression and mood changes in male weightlifters with and without androgenic anabolic steroid use. *Journal of Forensic Sciences*. 2003; 48:646–51. [PubMed: 12762541]
- Pope HG Jr, Kouri EM, Hudson JI. Effects of supraphysiologic doses of testosterone on mood and aggression in normal men: A randomized controlled trial. *Archives of General Psychiatry*. 2000; 57(2):133–140. doi:10.1001/archpsyc.57.2.133. [PubMed: 10665615]
- Pope HG, Katz DL. Affective and psychotic symptoms associated with anabolic steroid use. *The American Journal of Psychiatry*. 1988; 145:487–490. [PubMed: 3279830]
- Pope HG, Katz DL. Psychiatric and medical effects of anabolic-androgenic steroid use: A controlled study of 160 athletes. *Archives of General Psychiatry*. 1994; 51:375–382. doi:10.1001/archpsyc.1994.03950050035004. [PubMed: 8179461]
- Rubinow DR, Schmidt PJ. Androgens, brain, and behavior. *The American Journal of Psychiatry*. 1996; 153(8):974–984. [PubMed: 8678193]
- 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. *Annals of Epidemiology*. 2014; 24(5):383–398. doi:10.1016/j.annepidem.2014.01.009. [PubMed: 24582699]

- Shekelle PG, Hardy ML, Morton SC, et al. Efficacy and safety of ephedra and ephedrine for weight loss and athletic performance: A meta-analysis. *JAMA*. 2003; 289(12):1537–1545. doi:10.1001/jama.289.12.1470. [PubMed: 12672771]
- Shugar G, Schertzer S, Toner BB, di Gasbarro I. Development, use, and factor analysis of a self-report inventory for mania. *Comprehensive Psychiatry*. 1992; 33:325–331. doi: 10.1016/0010-440x(92)90040-w. [PubMed: 1395552]
- Sjöqvist F, Garle M, Rane A. Use of doping agents, particularly anabolic steroids, in sports and society. *The Lancet*. 2008; 371(9627):1872–1882. doi:10.1016/S0140-6736(08)60801-6.
- Spielberger, CD. The State-Trait Anger Expression Inventory, revised (STAXI-2). Psychological Assessment Resources, Inc.; Odessa, FL: 1998.
- Su T, Pagliaro M, Schmidt PJ, Pickar D, Wolkowitz O, Rubinow DR. NEuropsychiatric effects of anabolic steroids in male normal volunteers. *JAMA*. 1993; 269(21):2760–2764. doi:10.1001/jama.1993.03500210060032. [PubMed: 8492402]
- Tricker R, Casaburi R, Storer TW, Clevenger B, Berman N, Shirazi A, Bhasin S. The effects of supraphysiological doses of testosterone on angry behavior in healthy eugonadal men--a clinical research center study. *The Journal of Clinical Endocrinology & Metabolism*. 1996; 81(10):3754–3758. doi:10.1210/jcem.81.10.8855834. [PubMed: 8855834]
- Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*. 1988; 54:1063–1070. doi:10.1037/0022-3514.54.6.1063. [PubMed: 3397865]
- Yates WR, Perry PJ, MacIndoe J, Holman T, Ellingrod V. Psychosexual effects of three doses of testosterone cycling in normal men. *Biological Psychiatry*. 1999; 45:254–260. doi:10.1016/s0006-3223(98)00028-6. [PubMed: 10023498]
- Yates WR, Perry P, Murray S. Aggression and hostility in anabolic steroid users. *Biological Psychiatry*. 1992; 31:1232–1234. doi:10.1016/0006-3223(92)90344-y. [PubMed: 1391285]
- Yeun EJ, Shin-Park KK. Verification of the Profile of Mood States-Brief: Cross-Cultural Analysis. *Journal of Clinical Psychology*. 2006; 62:1173–1180. doi:10.1002/jclp.20269. [PubMed: 16688705]

Table1

Mood Scales by APED Use

Mood Measure	Stimulants		Steroids		Overall Model	APED Users vs. Norm
	No	Yes	No	Yes	F	d
SRMI - Mania	9.6(6.4)	10.9(5.8)	11.0(6.6)	9.0(5.7)	3.98 ^c	N/A
POMS-B						
Tension/Anxiety	2.9(3.0) ^a	3.4(3.8) ^a	3.0(3.1)	3.1(3.2)	11.27 ^c	.74 ^c
Depression/Dejection	2.1(3.0)	2.5(4.5)	2.0(3.1)	2.3(4.1)	15.62 ^c	.42 ^b
Anger/Hostility	3.3(3.6)	2.7(3.9)	3.0(3.2)	3.1(4.2)	6.94 ^c	.61 ^c
Vigor/Activity	9.0(4.2)	10.5(5.0)	10.5(4.2) ^a	8.6(4.7) ^a	9.34 ^c	.07
Fatigue/Inertia	4.8(3.5)	4.2(4.5)	4.4(4.0)	4.7(3.9)	3.42 ^c	.83 ^c
Confusion/Bewilderment	3.2(2.2)	3.7(2.8)	3.3(2.5)	3.3(2.4)	6.05 ^c	.54 ^c
ATQ - Positive Affect	110(13.8)	113(17.8)	113(13.1)	109(17.2)	19.46 ^c	1.81 ^c
STAXI-2						
Anger Feelings	7.5(2.7)	7.2(2.8)	7.2(2.5)	7.6(3.0)	4.49 ^c	-.08
Anger Verbal	7.4(2.7)	7.1(3.4)	7.6(3.7)	7.0(2.9)	2.90 ^c	-.20
Anger Physical	6.0(2.8)	5.5(1.9)	5.9(2.2)	5.8(2.8)	3.87 ^c	.08
Total Anger	21(7.8)	19.8(7.4)	20.7(7.4)	20.3(7.9)	4.26 ^c	-.08

Note. *F* = F-value,

APED = Appearance and performance enhancing drug, SRMI = The Self-Report Manic Inventory, POMS-B = The Profile of Mood States- Brief, ATQ = The Automatic Thoughts Questionnaire, STAXI-2 = The Revised State-Trait Anger Expression Inventory. In order to correct for multiple comparisons, alpha was set at $p < .025$ ($N = 122$). Means and standard deviations listed above are raw. Social desirability, trait affect, age, marital status, employment, income, recency of exercise, and hours of last sleep correlated with dependent variables and were included as covariates in the analyses. Other potential covariates measured did not have sufficient variance in the sample to account for variance in the final models, and so were not included. Cohen's *d* was calculated for the effect sizes in the final column, "APED Users vs. Norm," where only participants taking stimulants, steroids, or both ($N = 85$, which did not include participants not using either type of substance) were compared to normative samples in the literature (Ingram et al., 1995; Spielberger, 1998; Yeun and Shin-Park, 2006). A positive direction means that the norm was higher than our APED using subsample and negative direction means the APED subsample was higher.

^a $p < .025$,

^b $p < .01$,

^c $p < .001$,