Published in final edited form as:

Addict Behav. 2011 October ; 36(10): 949–958. doi:10.1016/j.addbeh.2011.05.002.

Development and Validation of the Appearance and Performance Enhancing Drug Use Schedule

Tom Hildebrandt, PsyD¹, James W. Langenbucher, PhD², Justine Karmin Lai, BA¹, Katharine L. Loeb, PhD¹, and Eric Hollander, MD³

¹Eating and Weight Disorders Program, Mount Sinai School of Medicine, One Gustave L. Levy Place, Box 1230, New York, NY 10029. Phone: 212-659-8673. Fax: 212-849-2561

²Rutgers, The State University of New Jersey

³Albert Einstein School of Medicine, New York, NY

Abstract

Appearance-and-performance enhancing drug (APED) use is a form of drug use that includes use of a wide range of substances such as anabolic-androgenic steroids (AASs) and associated behaviors including intense exercise and dietary control. To date, there are no reliable or valid measures of the core features of APED use. The present study describes the development and psychometric evaluation of the Appearance and Performance Enhancing Drug Use Schedule (APEDUS) which is a semi-structured interview designed to assess the spectrum of drug use and related features of APED use. Eighty-five current APED using men and women (having used an illicit APED in the past year and planning to use an illicit APED in the future) completed the APEDUS and measures of convergent and divergent validity. Inter-rater agreement, scale reliability, one-week test-retest reliability, convergent and divergent validity, and construct validity were evaluated for each of the APEDUS scales. The APEDUS is a modular interview with 10 sections designed to assess the core drug and non-drug phenomena associated with APED use. All scales and individual items demonstrated high inter-rater agreement and reliability. Individual scales significantly correlated with convergent measures (DSM-IV diagnoses, aggression, impulsivity, eating disorder pathology) and were uncorrelated with a measure of social desirability. APEDUS subscale scores were also accurate measures of AAS dependence. The APEDUS is a reliable and valid measure of APED phenomena and an accurate measure of the core pathology associated with APED use. Issues with assessing APED use are considered and future research considered.

Keywords

ANABOLIC-ANDROGENIC STEROID; POLYSUBSTANCE USE; BODY IMAGE DISTURBANCE; COMPULSIVE EXERCISE; PSYCHOMETRICS; RELIABILITY; VALIDITY; APPEARANCE AND PERFORMANCE ENHANCING DRUG USE

© 2011 Elsevier Ltd. All rights reserved.

Correspondence to: Tom Hildebrandt.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

1.0 Introduction

The purpose of this study is to describe the initial development and psychometric properties of the Appearance and Performance Enhancing Drug Use Schedule (APEDUS), a semi-structured interview designed to assess the key clinical features and phenomena associated with APED use. The APEDs are usually discussed under the rubric of anabolic-androgenic steroid (AAS) use or in the context of cheating athletes whose APED use varies by the demands of the sport and ever changing need to avoid detection (Bahrke & Yesalis, 2004; Kazlauskas, 2010; Millman & Ross, 2003). The data on human AAS or APEDs are sparse and limited to a handful of field studies (e.g. Bahrke, Wright, Strauss, & Catlin, 1992; Copeland, Peters, & Dillon, 2000; Evans, 1997; Kanayama, Hudson, & Pope, 2009; Lindstrom, Nilsson, Katzman, Janzon, & Dyming, 1990; Midgley, Heather, & Davies, 2001; Pope & Katz, 1994) and more recently several large sample studies conducted via the internet (Hildebrandt, Langenbucher, Carr & Sanjuan, 2007; Parkinson & Evans, 2006; Perry, Lund, Deninger, Kutcher, & Schneider, 2005), which suggest that APED use is heterogeneous, but unified by the common goals of improved appearance or athletic/occupational performance. There are number of basic drug related features that have evolved out of this research, but there remains little standardization of drug-based or related phenomena such as body image disturbance, dietary control, or exercise. This limitation makes comparison across studies difficult and it has slowed attempts to develop a comprehensive and valid nosology for APED use. The APEDUS provides a comprehensive assessment of these core features.

1.1 The Conceptual Framework of APED Use

The phenomenology of APED use has been viewed through several different conceptual frameworks. The most common of these frameworks is the classic AAS abuse-dependence model of drug addiction, which relates the primary drug-based pathology to the ability of AASs to hijack the motivation-reward system (Wood, 2008). In addition, this addiction framework builds upon observable and definable tolerance and withdrawal syndromes (Brower, Eliopoulos, Blow, Catlin, & Beresford, 1990; Brower, Blow, Young, & Hill, 1991; Kashkin & Kleber, 1989), which are fundamental to defining substance use disorders (SUDs). However, these symptoms as well as other diagnostic features (e.g., impairment in occupational functioning, excessive time spent using or recovering from drug effects) of SUDs do not map well onto the phenomena of AAS use for several reasons. Specifically, AASs do not have a definable intoxication syndrome, the preoccupations and compulsive behavior are expressed in the domains of exercise, dietary control, and body image (as opposed to drug seeking), the acute effects of AASs do not lead to occupational impairment, and the distress associated with withdrawal is primarily related to changes in outward appearance or drop in performance (Kanayama, Hudson, & Pope, 2009). An expanded version of the abuse-dependence model uses associated features of compulsive exercise and body image disturbance to increase its validity (Kanayama, Brower, Wood, Hudson, & Pope, 2009a; Kanayama, Brower, Wood, Hudson & Pope, 2009b), but maintains the SUD construct of drug dependence.

An alternative framework includes AAS use in the broader context of drug use aimed to alter one's appearance or improve occupational and physical performance (Hildebrandt, Langenbucher, Carr, & Sanjuan, 2007). This latter framework considers three basic phenomenological features to be essential to the practice of APED use: (a) body image disturbance, (b) training and exercise, (c) dietary control and is the basis for a revised theoretical approach that weighs each domain equally in the observed pathology of APED use (Hildebrandt et al., 2010). This model assumes that none of the leading models of AAS use (eating disorders, sport psychology, substance use disorder, or body image disturbance) adequately capture this complex form of drug use. It also draws from the observed drug use

patterns of most AAS users included in the published field studies, which suggest a pattern of multi-substance use that spans illicit substances (e.g., synthetic hormones, fertility medications, prescription pain killers, stimulants) to more widely available nutritional supplements, diet pills, and prohormones (Skarberg, Nyberg, & Engstrom, 2009). This expansive polypharmacy has been shown to correlate with negative physical and psychological consequences to APED use and be predictive of intentions for long-term use (Hildebrandt, Langenbucher et al., 2006; Hildebrandt et al., 2007). Finally, the latter framework recognizes the role of the APED lifestyle in the larger phenomena of APED use and specifically the role of experience and information exchange between users that occurs about drug use and management or prevention of side effects (Monaghan, 2002). The APEDUS is built on this larger theoretical framework that draws from the reported phenomenology of APED use in a “bottom-up” approach to defining and understanding APED use.

The approach to psychopathology utilized by the APEDUS is also intended to be transdiagnostic. Specifically, the severity ratings for items in the body image, exercise, and dietary sections of the APEDUS are designed to capture variability in cognitive or behavioral disinhibition, whether compulsive or impulsive in function. This approach is consistent with evolving neurobiological and phenomenological research unifying both compulsive and impulsive forms of psychopathology along a continuum (Fineberg, et al., 2010; Grant & Potenza, 2006; van den Heuvel, et al., 2010). Thus, the severity ratings of these APEDUS scales are grounded in the clinical models that identify difficulty inhibiting behavior or types of thinking as pathological, with more difficulty in these forms of inhibition reflecting a greater degree of psychopathology.

1.2 Core Drug Use Phenomena

The AASs encompass the synthetic male sex hormones including testosterone, nortestosterone, and their derivatives (Shahidi, 2001) and are often the primary substance in a typical pattern of illicit APED use (Hildebrandt et al., 2007). The core feature of APED use is the APED “cycle”, which refers to a pattern of planned duration, dosage, and drug type in which the APED user “stacks” these substances in efforts to maximize some functional or desired outcome (e.g., increased muscularity or athletic performance). Cycles are often followed by a period of post-cycle recovery, where APED users allow for stabilization of their hypothalamic-pituitary-gonadal (HPG) axis. There is likely a mild withdrawal syndrome among heavy APED users (Kanayama, Brower, Wood, Hudson, & Pope, 2009c) and evidence of the opiate-mediated reinforcing effects of androgens (Wood, 2004, 2008). The reinforcing aspects of other APEDS are less understood, and there are some animal data suggesting that AASs interact with other drugs of abuse such as cocaine (Mantinez-Sanchis, Aragon, & Salvador, 2002) and other stimulants (Kurling, Kankaanpaa, & Seppala, 2008) to enhance their reinforcing properties.

Over the course of an APED cycle, users are likely to experience any of a wide range of side effects that vary in severity. Exploratory factor analyses of side effects among experienced APED users suggest a wide range of psychological, medical, endocrinological, musculoskeletal, cardiac, and sexual side effects that relate to both anabolic and catabolic substances (Hildebrandt et al., 2007). Although certain side effects are common, the probability of severe or long term consequences is unknown (Evans, 2004), but are likely to include negative cardiac effects (Samenuk, Link, & Homoud, 2002; Urhausen, Albers & Kindermann, 2004) and psychiatric disturbances for some APED users (Hall & Chapman, 2005). The most widely described of these psychiatric consequences is an elevation in aggression, hostility, and irritability (Trenton & Currier, 2005).

APED users also report a number of unique benefits to APED use including gains in strength and muscle mass, confidence, sex drive, ability to concentrate, or feelings of dominance (Hildebrandt, Langenbucher et al., 2006; Hartgens & Kuipers, 2004). These desired consequences mirror self-reported motivations for AAS use which also include functional outcomes such as increasing the ability to commit a crime and fighting ability (Copeland et al., 2000; Petersson, Bengtsson, Voltaire-Carlsson & Thiblin, 2010). The primary use of AASs and other APEDs, however, is for changes to outward appearance via alteration to muscle mass and body fat. The data largely support the ability of AASs and other anabolics such as insulin-like growth factor (IGF-1) or human growth hormone (HGH) to increase muscle and reduce body fat (Bhasin et al., Birniece, Nelson & Ho, 2010; 1996; Frisch, 1999; Hoffman et al., 2009; Woodhouse et al., 2003; Woodhouse et al., 2004). The effects of stimulants or other drugs such as thyroid hormones on body fat reduction are not well documented in this population, although certain drugs such as ephedrine are known to have efficacy for short-term weight loss in obese populations (Molnar, Torok, Erhardt & Jeges, 2000).

1.3 Core Behavioral and Attitudinal Features

In addition to strictly drug related phenomena, APED use includes exercise and dietary patterns aimed at achieving appearance or performance specific goals. Although little systematic data exist documenting dieting or exercise patterns of APED users, these practices are considered essential to the desired effects of APEDs. For instance, APED users, particularly those who are bodybuilders, will often strictly adhere to prescribed macronutrient and caloric regimens (Lambert, Frank & Evans, 2004). Among some APED users, these practices may develop into a pattern of binge eating, dietary restraint, and purging similar that that found among women with bulimia nervosa (Goldfield, Blouin & Woodside, 2006). In a community sample of male weightlifters, Hildebrandt, Schlundt, Langenbucher, & Chung (2006) found evidence for a specific subgroup with elevated symptoms of binge eating and purging that co-occurred with the highest rates of legal and illegal APED use. Thus, strict dietary control and the consequential loss of control that occurs during binge episodes are likely to be a marker of pathology among APED users.

Exercise plays a fundamental role in APED use because it is necessary to bring about the desired effects on one's outward appearance or improved performance. Pathological forms of exercise are typically defined as compulsive or as a type of behavioral addiction (De Coverley Veale, 1987; Hauk & Blumenthal, 1992; Smith & Hale, 2005). Survey data suggest that compulsive exercise does not correlate with eating disturbances and is likely to be its own unique behavioral feature (Guidi et al., 2009). Furthermore, excessive exercise is known to have its own direct effects on the motivation-reward system (Hamer & Karageorghis, 2007; Mathes et al., 2010), possibly mediated through the release of beta-endorphin (Goldfarb & Jamurtas, 1997). Perhaps more important is the interaction between exercise and AASs to increase the reinforcing value of exercise (Wood, 2002). This latter finding suggests that APEDs and exercise may interact to disrupt the motivation-reward system and increase the risk for an APED dependence syndrome. Exercise typically involves some combination of aerobic and anaerobic activities depending upon the specific goal, the most common activity being weightlifting. The types of exercise utilized by APED users may also influence the type of APEDs used. For instance, bodybuilders tend to use the greatest diversity of APEDs whereas powerlifters tend to use mainly AASs (Hildebrandt, Langenbucher et al., 2007). Thus, exercise is an important aspect of the APED user lifestyle that has direct influence on the effects of certain APEDs as well as the types of APED used.

Body image is also a core aspect of APED phenomena. There are some data to suggest increased body image disturbance among a subset of APED users (Kanayama, Barry, Hudson & Pope, 2006; Mangweth et al., 2001), particularly those with specific psychiatric

disturbances such as muscle dysmorphia (Pope, Gruber, Choi, Olivardia & Phillips, 1997). Investigations of this construct suggest a great deal of variability in the degree of satisfaction with appearance. Some investigations suggest APED users have greater body esteem (Hurst, Hale, Smith & Collins, 2000; Pickett, Lewis & Cash, 2005), while other data suggest APED users are more dissatisfied with their appearance (Blouin & Goldfield, 1995; Kanayama, Pope, Cohane & Hudson, 2003). The degree of investment in one's appearance appears to be a key feature of body image disturbance as those who are highly invested tend to report the heaviest and most risky APED use (Hildebrandt, Alfano & Langenbucher, 2010). Behavioral indicators of body image disturbance suggest body checking (e.g., mirror gazing, flexing, etc.) may be a particularly important correlate of APED use and reflective of impairment (Walker, Anderson & Hildebrandt, 2009). Thus, compulsive forms of body image disturbance may be particularly important to understanding pathological patterns of APED use.

1.4 Social Context of APED Use

Although rarely described, there is an important social aspect of APED use. There is a strong community of individuals who support each other, their goals for appearance or performance, and the improvement in quality of life associated with APED use and associated practices (diet and exercise). This community regulates much of the information about APEDs and how to use them among APED users, often providing secondary prevention of risky APED use (Monaghan, 2002). However, APED users remain distrustful of the medical profession and their ability to provide accurate information about APEDs and their effects (Pope, Kanayama, Ionescu-Pioggia & Hudson, 2004). The disconnection between medical and APED using communities is likely to be a significant barrier to intervention, prevention, or harm reduction efforts in this population. However, little systematic data exist on the social context of APED use.

1.5 Risk and Future APED use

Defining the risks associated with APEDs is complex. The consensus emerging from in depth reviews of the literature suggest that the significant risks are likely to be associated with long-term use of APEDs (Kanayama, Hudson & Pope, 2008). This argument is built upon some epidemiological data that suggests higher rates of violent death among APED users (Petersson, Garle, Granath et al., 2006; Petersson, Garle, Holmgren et al., 2006) as well as the cardiac data that suggest increased dysregulation of left ventricular function (Baggish et al., 2010). There is a high prevalence of mild physical and psychiatric side effects among APED users (Evans, 2004) that must be tolerated to persist with chronic APED use. It is this persistence, or investment in the long-term use of APEDs, that brings the greatest risks of morbidity and mortality. In particular, the adherence to APED use despite physical, social, or legal consequences is indicative of the type of user that is at highest risk for experiencing the more severe long-term effects of this type of drug use.

2.0 Material and Methods

2.1 Participants

Participants were recruited at two sites (Rutgers University and Mount Sinai School of Medicine) via posting flyers at gyms and nutritional supplement stores, posting on fitness, bodybuilding, and anabolic-androgenic steroid discussion boards, newspaper advertisements, and general volunteer websites to complete a series of assessments. Inclusion criteria included (a) current illicit APED use, defined by having used an illicit APED in the past 12 months and planning on using illicit APEDs in the future; (b) at least 18 years old. Potential participants were excluded if they endorsed any symptoms of psychosis as assessed by the psychotic screen of the structured clinical interview for

Diagnostic and Statistical Manual (DSM) fourth edition (SCID I; (First, Spitzer, Gibbon & Williams, 2007). Of 153 contacts, 85 (71 males and 14 females) were eligible and participated in the study. The primary reasons for exclusion included not using an APED that was illegal or no plans to use APEDs in the future. Sample demographic by site are reported in Table 1. All participants received \$100 US for their participation.

2.2 Semi-structured interviews

2.2.1 Appearance and Performance Enhancing Drug Use Schedule—Items for the APEDUS were adopted and expanded based on an online measure used in previous studies (Hildebrandt, Langenbucher et al., 2006; Hildebrandt, et al., 2007). During these earlier studies, the first two authors' (TH & JWL) elicited feedback from the APED community via open ended discussions associated with the online measure. Themes from this feedback and empirical data were used to identify relevant domains of experience and specific aspects of the APED lifestyle that were relevant to regular APED use. Consequently, the authors generated item sets drawing from these data and the published qualitative and observational research on APED use (e.g. Copeland et al., 2000; Monaghan, 2002). Items were then shared with the remaining authors (KL and EH) for content validity and to ensure consistency with the desired approach of scaling severity along a continuum of cognitive and behavioral disinhibition. Six pilot interviews were then conducted with current APED users by TH and JWL with feedback from interviewees incorporated into a final version for formal evaluation.

There are 10 independent sections and the final version of the interview is freely available for download (See <http://www.mssm.edu/research/programs/appearance-and-performance-enhancing-drug-program/publications>). Table 2 summarizes the sections and their content. Each module is designed to be used independently, so the instrument may be adapted to specific study aims. The interview utilizes several different response formats including 7-point ordinal scales for severity or frequency ratings with these items referenced to the past 28 days. Other items are recorded as either presence or absent and descriptive data recorded specifically for drug doses. To aid in gathering information, the APEDUS relies on four Appendices which are shared with the interviewee to identify side effects (on-cycle & post-cycle) as well as types of APEDs (Cycle specific and Ancillaries). By periodically updating these appendices, the APEDUS may be adapted to the evolving APED market without changing the structure of the basic instrument. The scoring instructions can be found in the introduction to the APEDUS.

All interviewers (two at each site with at least a Masters degree) received 16 hours worth of training on the APEDUS by the authors (TH & JWL). This training included (a) overview of interview style and technique, (b) didactic information about APEDs, (c) discussion of APEDUS item content and structure, (d) role plays of APEDUS interviews, and (e) trouble shooting and special populations or circumstances. All interviewers were required to co-rate an APEDUS conducted by one of the authors on a pilot subject and reach >90% agreement on all ratings. Items where divergence occurred were discussed until resolved. Interviewers were then observed by one of the authors, with the same standard for agreement before the interviewer was able to conduct independent interviews. Randomly, the authors listened to taped interviews and provided feedback throughout the duration of the study. Agreement between authors and independent raters was never below 90%.

2.2.2 SCID-I Substance Abuse/Dependence and Impulse Control Disorders Modules (First et al., 2007)—Interviewers were trained on the SCID-I and had to achieve 90% agreement with the PIs before independently conducting assessments. The

SCID has demonstrated excellent reliability and validity for substance use in other samples (Segal, Hersen & Van Hasselt, 1994). Lifetime AAS abuse and dependence were investigated using strict adherence to the existing SCID criteria. The criteria recommended by Kanayama, Brower et al. (2009b) for AAS dependence were not available at the time of the study, so APED was used as the drug category with *SCID-I* scoring rules employed.

2.2.3 Yale-Brown Obsessive-Compulsive Scale—Body Dysmorphic Disorder (YBOCS-BDD; (Philips et al., 1997))—The YBOCS-BDD is a 12-item semi-structured interview that measures the severity of body related obsessions, compulsions, and rituals and yields a total symptom severity score for BDD. Scores range from 0 to 48 with a score of >12 is considered to represent those with clinically significant BDD (Philips et al., 1997) and is considered the gold-standard assessment scale for symptoms of BDD (Cororve & Gleaves, 2001).

2.3 Self-Report Questionnaires

2.3.1 Symptom Checklist List-90-Revised (SCL-90-R(Derogatis, 1977))—The SCL-90 is a widely used measure of psychopathology with scores ranging from 0-360 and scores of above 60 being considered in the pathological range. Although subscales exist, we used the total score as a global measure of global psychopathology and impairment. Coefficient alpha for the total score in this sample was $\alpha = .98$.

2.3.2 Muscle Dvsmorphic Disorder Inventory (MDDI (Hildebrandt, Langenbucher & Schlundt, 2004))—The MDDI is a 13-item measure of the body image disturbance and is comprised of three subscales (Appearance Intolerance, Desire for Size, and Functional Impairment) and a total score. The Functional Impairment scale assesses the degree to which an individual's exercise practices interfere with social and occupational functioning. The coefficient alpha for the total score and Functional Impairment subscale in the study sample were $\alpha = .92$ and $.94$ respectively.

2.3.3 Body Checking Questionnaire (BCQ; (Reas, Whisenhunt, Netemeyer, & Williamson, 2002) and Male Body Checking Questionnaire (MBCQ; (Hildebrandt, Walker, Alfano, Delinsky & Bannon, 2009))—The BCQ and MBCQ measure the frequency of body evaluation and body checking in female (BCQ; 23 items) and male (MBCQ; 16-items) specific patterns over the past two weeks and have been designed to be used together with equivalent response formats. Both measures have specific subscales and global scale scores, the latter of which were used in the current study. The coefficient alphas for global scale scores in the current study were $\alpha = .95$ and $\alpha = .96$ respectively.

2.3.4 Eating Disorder Examination-Questionnaire (EDE-Q; (Fairburn & Beglin, 1994))—The EDE-Q is 41-item self-report measure of the core behavioral (e.g., objective bulimic episodes, vomiting episodes, etc.) and attitudinal (i.e., Shape Concern, Weight Concern, Eating Concern, and Restraint) symptoms among those with eating disorders over the past 28 days. A Global Scale score is used to index overall eating disorder symptom severity and provides a range from 0 to 6 with 4 representing a clinical cutoff for eating disorder pathology. The Eating Concern and Restraint subscales were used to evaluate the convergent validity of the Dietary History and Practices subscale of the APEDUS. The Shape and Weight Subscales were used to evaluate convergent validity of the Body Image and Appearance Control subscales of the APEDUS. Coefficient alphas in the current sample were $.82$, $.72$, $.73$, and $.84$, and for the Shape Concern, Weight Concern, Eating Concern, and Restraint subscales and $.92$ for the Global Scale.

2.3.5 Buss-Perry Aggression Questionnaire (BPAQ; (Buss & Perry, 1992))—The BPAQ is a 29-item questionnaire that measures one's overall experience of aggressive attitudes and behavior. Higher scores reflect more aggressive attitudes and behaviors with no clinical cutoffs for psychopathology. There are four subscales (Physical Aggression, Verbal Aggression, Anger, and Hostility) and a global score. Coefficient alpha for the total score in the current sample was $\alpha = .93$. The BPAQ -total score was used to measure the convergent validity of the APEDUS side effect scales.

2.3.6 Baratt Impulsivity Scale (BIS-11; (Patton, Stanford & Barratt, 1995))—The BIS is a 30-item trait measure of impulsivity comprised of six first order factors and three second order factors. A global score comprised of the sum of each of the six first order factors was used as measure of convergent validity for the side effect scales of the APEDUS. Higher scores reflect more impulsivity and the coefficient alpha for the current study was $\alpha = .79$.

2.3.7 Work-Social Adjustment Scale (WSAS; (Weissman & Bothwell, 1976))—The WSAS is a 5-item self-report measure that assesses the degree to which symptoms interfere with occupational role functioning. Higher scores reflect greater impairment levels. The WSAS was used as a convergent validity measure for the side effect subscales of the APEDUS. Coefficient alpha for the current sample was $\alpha = .89$.

2.3.8 Marlowe-Crowne Social Desirability Scale (MCSDS; (Crowne & Marlowe, 1960))—The MCSDS is a 33-item measure of social desirability conceptualized as the need for approval or social acceptability. Higher scores reflect a greater desire to be accepted and approved by society. The MCSDS was used as a measure of divergent validity and the Kuder-Richardson-20 score was .91.

2.4 Anthropometric and Doping Measures

Height, obtained by stadiometer, weight in pounds via digital scale, and body fat percentage (body calipers, three points) was collected for each participant. Body mass index (BMI) was calculated as a measure of overall size. Sixteen participants were randomly selected to provide a urine sample (50 ml) which were stored at 4 degrees C until analysis for specific APEDs using gas chromatography and mass spectrometry (Anti-Doping Research, Inc.; Los Angeles, USA).

2.5 Design and Analyses

Participants completed assessments with a randomly selected subsample ($n = 16$) receiving urine analysis to verify validity of self-report and ($n = 21$) to complete a second APEDUS one-week later ($M = 1.26$ $SD = 1.04$) weeks later by a blinded interviewer. APEDUS interviews were audio taped and coded by blinded, trained assessors for inter-rater reliability. Reliability coefficients [Coefficient alpha (α), κ , interclass correlation coefficient (ICC), or Kuder-Richardson-20 (KR-20)] were calculated for the scale items and for sum score of each module. Individual item reliability scores are available upon request and ranges for APEDUS item reliability are reported. Kappa coefficients (κ) were calculated to evaluate the accuracy of specific APED self-report. For those reporting current APED use, agreement was present if results of the urine analysis included drug specific metabolites or evidence of the self-reported drug in the lab report. For those reporting no current use, agreement was present if there was no evidence of APED use in the urine sample.

For each of the APEDUS subscales (Training History and Identity, Dietary History and Practices, Body Image and Appearance Control, Social Context of APED use, and Risk and Future Use), we assumed an unidimensional item within each module. Certain items within

each module were considered descriptive and not part of the respective scale item pool. These items included information about age of onset for specific behaviors or descriptive information about types of behavior (e.g., dieting approach, type of exercise, etc.) The sample size did not provide for exploratory factor analyses, so preliminary tests of dimensionality were conducted. Each module subscale was subjected to confirmatory factor analysis to evaluate the fit of a single factor model and these results are available from the first author. Each subscale had a root-mean-square error of approximation $> .08$ providing some evidence for their validity as single dimensions.

Construct validity was established by examining the relationship between APEDUS drug use modules and SCID diagnoses. In particular, APED use behavior was correlated with AAS dependence criteria to determine if those reporting greater exposure to APEDs and more intense use patterns (i.e., higher doses, longer duration, more substances, and more side effects) had greater likelihood of meeting criteria for AAS dependence. Sensitivity, specificity, and receiver operator characteristic (ROC) curves (Greiner, Pfeiffer & Smith, 2000; Linden, 2006) were used to evaluate the ability of each subscale to identify problematic APED use. Area under the Curve (AUC) was used to provide a measure of the overall accuracy of each subscale derived from the ROC curve analysis. The relationship between APEDUS subscales and other convergent measures examined through multiple regression analyses, with demographics (age, education, income, marital status, and employment status) as covariates.

3. 0 Results

3.1 Sample Description and Drug Use Patterns

The sample reported exercising $M = 19.01$ ($SD = 6.33$) days per month and $M = 1.45$ ($SD = .87$) hrs per exercise day. They began regularly exercising (i.e., more days than not for at least six months) at age $M = 15.48$ ($SD = 7.16$). Exercise was aimed slightly more towards mass building, power or strength than endurance or cardiovascular health ($M = 3.51$, $SD = 2.23$; 0-6 scale range from exclusive use of endurance exercise to exclusive use of mass building or strength exercise; 3 = to equivalent reliance on cardiovascular exercise versus mass building, power, or strength). The first formal attempts at controlling diet began at age $M = 20.44$ ($SD = 8.62$) and participants reported sticking to a specific diet $M = 21.60$ ($SD = 9.77$) days during the past month. Participants described their approach to dietary control over the past month as primarily aimed at maintaining energy balance through caloric control ($M = 2.64$, $SD = 1.76$; 0-6 scale range from “extreme underconsumption” to “extreme overconsumption” of calories; 3 = “energy balance”), with notable macronutrient control ($M = 3.51$, $SD = 2.19$; 0-6 scale range from “no macronutrient control” to “exclusive use of macronutrient content” to make decisions about food; 3 = “equivalent reliance on macronutrients and other aspects of food”).

Descriptive information on patterns of APED use is reported in Table 3. The most commonly used illicit APED was “D-Bol” or methandrostenolone (19.7%) with a total at 39 different illicit APEDs endorsed during the first cycle. For the most recent cycle, the most commonly used illicit APED was also methandrostenolone (13.9%), with a total of 42 different illicit APEDs endorsed during the most recent cycle. In their lifetime APED use, participants endorsed having used 59 different substances with the most common being methandrostenolone (19.7%), followed by “Deca” or nandrolone decanoate (18.0%), anavar or oxandrolone (16.4%), and “EQ” or boldenone undecylenate (16.4%). Nolvadex or tomatofine citrate, a substance used to prevent or treat gynecomastia, was the most commonly used ancillary drug during the first cycle (17.9%), most recent cycle (18.0%), and lifetime (42.9%).

3.2 APEDUS Inter-Rater, Test-Retest, and Scale Reliability

Table 4 summarizes reliability coefficients for the items and scales included within each module. High interclass correlation coefficients indicate the interviews can be reliability rated by trained interviewers ($ICC = .86-.96$; $\kappa = .74-1.0$). Each module's items and scale score also demonstrated stability over a short duration, even with blind follow-up interviewers at the second time point. Furthermore, measures of internal consistency suggested scale items were highly inter-correlated ($\alpha = .72-.93$). There was no evidence that deletion of any single item would significantly improve scale reliability for any of the scales. Descriptive items (e.g., age of first regular exercise, age of first attempt at dietary control, etc.) were also stable over time suggesting the descriptive information gathered is also reliable.

3.3 Convergent, Divergent, and Construct Validity of APEDUS subscales

Table 5 summarizes beta coefficients for multiple regression analyses (MRA) examining the relationship between ABEDUS scales and the respective convergent measures. All MRAs included age, marital status, income, years of education, gender, and BMI as predictors so beta coefficients are estimates of unique contribution of the convergent measure. Collinearity diagnostics for all regressions indicated reasonable tolerance (all below .71), suggesting the measures were adequate for simultaneous entry into MRAs. The results suggested that all APEDUS subscales were significantly correlated with measures of convergent validity, with a few exceptions. The Dietary Control subscale was not significantly correlated with the Restraint subscale of the EDE-Q, the Risk and Future Use was not significantly correlated with the number of APED cycles, and the Global Side Effects was not significantly correlated with SCL-90 and BP-Aggression. However, the Dietary Control subscale was predictive of objective binge episodes in the past 28 days; MRA ($\beta = 2.23$, $SE = .45$, $p < .001$, $R^2 = .211$). All subscales were uncorrelated with MCSDS total scores, suggesting divergent validity.

The sensitivity and specificity of subscales for predicting AAS dependence also supported construct validity. Sensitivity measures the degree to which those diagnosed with AAS dependence were correctly classified as dependent by the continuous scale. Sensitivity measures the degree to which those who are diagnosed without AAS dependence are correctly classified as non-dependent by the continuous scale. The threshold of the continuous scale (τ) where sensitivity and specificity are maximized provides a guideline for establishing clinical cutoffs of the scale. The plotting of sensitivity and specificity at different levels of the continuous scale yields a receiver operator characteristic (ROC) curve, the area underneath this curve (AUC) provides an overall measure of scale accuracy. ROC curves for Body Image and Appearance Control ($AUC = .860$, $SE = .086$, $p < .01$, sensitivity = 83.33, specificity = 95.00, $\tau = 1.44$), Exercise and Training ($AUC = .796$, $SE = .101$, $p < .01$, sensitivity = 80.00, specificity = 95.00, $\tau = 1.65$), and Risk and Future Use ($AUC = .749$, $SE = .091$, $p < .01$, sensitivity = 60.00, specificity = 92.50, $\tau = 1.14$) subscales suggested these scales are accurate measures of AAS dependence. The Dietary control subscale ($AUC = .627$, $SE = .123$, $p = .35$, sensitivity = 40.00, specificity = 91.25, $\tau = .24$) and Current Cycle Benefits subscale ($AUC = .680$, $SE = .151$, $p = .187$, sensitivity = 57.14, specificity = 91.25, $\tau = 2.42$) were not accurate predictors of AAS dependence.

The relationship between the Risk and Future use subscale was also suggested by significant correlations with specific descriptive items. In particular, Risk and Future use scores were significantly correlated (after controlling for age) with duration of planned continued APED use ($r_{\text{partial}} = .251$, $p < .01$), the likelihood of giving up APED use given proof of long-term negative consequences ($r_{\text{partial}} = -.297$, $p < .01$), and the number of years of life he/she was willing to sacrifice to achieve his/her training related goals ($r_{\text{partial}} = .276$, $p < .01$).

Descriptively, 31.7% of users reported having shared their supply with others at least once, and reported knowing many ($M = 29.31$, $SD = 116.91$) individuals who also used APEDs. At total of 63.5% reported giving advice to others about maximizing their APED use or managing APED side effects.

3.4 Sensitivity and Specificity of Drug Self Report

Results of urine analyses were compared against subject self report. Considered as a simple presence or absence measure (reporting being on-cycle vs. off-cycle) compared to evidence of any APED metabolite, participants were accurate ($\kappa = .68$, $SE = .21$, $p < .01$, agreement = 90.0%). For this measure, sensitivity was 100.00 and specificity was 75.00. One of four participants reporting to be off cycle tested positive for methyltestosterone and one of 12 participants reporting to be on-cycle had no evidence of any APED use. The former inaccuracy may have been related to current use of a nutritional supplement that was contaminated. When considering the specific drugs self-reported, the level of accuracy decreased ($\kappa = .54$, $SE = .11$, $p < .01$, agreement = 77.8%). Sensitivity for specific drug was 82.05 and specificity was 71.42.

4.0 Discussion

The present study reports on the first attempt to standardize measurement of the core phenomena associated with APED use. Developed from existing descriptive research on APED users (Hildebrandt, Langenbucher et al., 2006; Hildebrandt et al., 2007), the APEDUS assesses information on several key aspects of APED use in a single instrument. APEDUS item scores are stable over short periods of time (1-2 weeks) and independent raters achieve high levels of agreement on individual items and scale scores. Significant correlations between APEDUS subscale scores and specific measures suggest convergent validity, with the exception of the Global Side Effects subscale. This could be partially related to the nature of the selected convergent measures, which measured either global or specific types of psychopathology. The majority of side effects included in the item pool were physical. Evidence for the Mood and Affective Side Effects subscale positive correlation with global psychopathology and aggression indicated that specific side effects are correlated with specific measures. Interestingly, trait impulsivity was significantly correlated with both mood and global side effects. This finding suggests that trait impulsivity may underlie certain types of risks associated with APED use.

In terms of construct validity, the Body Image and Appearance Control, Training and Exercise, and Risk and Future Use, subscales were highly sensitive and specific measures of AAS dependence. The Dietary Control subscale and Current AAS Benefits were comparatively poor predictors of AAS dependence. The Dietary Control subscale also had the weakest relationship with convergent measures. Although it may measure disturbances in dietary control, this feature may not be a unique characteristic of those who are dependent upon AAS. Rather, the types of dietary control measured by this APEDUS subscale is likely to measure eating marked by a loss of control. Research on AAS dependence suggests that about 30% meet criteria for *DSM-IV* dependence upon interview or self-report (Kanayama, Hudson et al., 2009a), but alterations have been suggested to these criteria (Kanayama, Brower, 2009b; Kanayama, Brower et al., 2009c) that incorporate physical exercise and body image concerns.

The results from this study also suggest that self-report of APED use is relatively accurate, in particular, when considered as the presence or absence of APED use. This accuracy diminishes as specific substances are considered, but this may be related to drug contamination from nutritional supplements. There is some data suggesting that about 15% of commercially available nutritional supplements may contain prohormones or other

anabolic agents (Geyer et al., 2008; Martello, Felli & Chiarotti, 2007). Thus, the use of these legal substances must also be taken into account when determining the accuracy of APED user self-reports. There was also evidence that one individual who believed he was taking an AAS had no evidence of any APED in his urine. It is possible that he was sold a counterfeit substance or that he was faking his use in order to participate in the study. With regard to self-report accuracy, we also observed throughout the study that a small subgroup of users reported no knowledge of the specific substance they were taking or the doses of these substances. These users were asked to investigate their own use and report in as much detail as possible the specifics of their drug use. For those presenting with this lack of specific knowledge, they reported taking explicit directions from a friend or dealer. Thus, some users might be poor historians of their use and this seems to be related to a pattern of deferred responsibility for the APED cycle.

There were some limitations to this study. The modest sample size prevented a thorough investigation of the dimensionality and factor structure of each specific subscale, although the basic psychometric properties were sound (internal consistency, test-retest reliability, and inter-rater reliability). The sample size also prevented any attempts at generating population norms. Independent of sample sizes, population norming may be difficult for certain aspects of the measure may be difficult as the market for APED use continues to evolve rapidly. This constant evolution could lead to changes in population norms related to drugs or drug patterns. Although the goals of the initial study intended to recruit equivalent samples of men and women, very few APED using women responded to advertisements and recruitment efforts. This may be due to low prevalence rates among females (Kanayama, Boynes, Hudson, Field & Pope, 2007) and also related to specific stigma experienced by women who use APEDs. Female APED users may be at increased risk for medical and psychiatric consequences (Gruber & Pope, 2000), so continued efforts to study APED use in this population will be important in the future. The construct validity of the APEDUS side effects subscales will have to be validated against a medical evaluation or cognitive tests as many of the questions pertain to specific physical side effects or cognitive disturbances that would require medical tests to verify (e.g., blood pressure, liver enzymes, etc.). Finally, there are little epidemiological data available to establish representativeness of an APED using sample. The majority of field and large sample studies (as opposed to epidemiological studies) suggest that users tend to be on average, single, well-educated, and middle class. Because acute APED use is unlikely to lead to functional impairment in occupational settings, this difference from classic substance abusing populations is not surprising. However, the sample in this study was ethnically diverse and included a wide range of age, education, and socioeconomic status.

In conclusion, the APEDUS offers a standardized semi-structured interview with good psychometric properties for use with current APED using populations. Long-term reliability, factorial validity, and specific types of construct validity will need to be investigated in future research. Furthermore, the ability for different research groups to reliably code APED use behavior will be a necessary test as well as the possibility of converting certain scales to straight self-report format to reduce time burden. Finally, the APEDUS would appear to generate information relevant to AAS dependence and may help in future investigations of the construct validity of this diagnostic category as information relevant to this diagnosis can be gathered in a single instrument.

Acknowledgments

This research was supported by National Institute on Drug Abuse grant NIDA R03 1R03DA022444-01 awarded to Dr. Hildebrandt (PI), Drs. Langenbucher, Loeb, and Hollander (Co-Is).

References

- Baggish AL, Weiner RB, Kanayama G, Hudson JI, Picard MH, Hutter AM, Pope HG Jr. Long Term Anabolic-Androgenic Steroid Use is Associated with Left Ventricular Dysfunction. *Circulation: Heart Failure*. 2010; 3:470–471. [PubMed: 20647488]
- Bahrke MS, Wright JE, Strauss RH, Catlin DH. Psychological moods and subjectively perceived behavioral and somatic changes accompanying anabolic-androgenic steroid use. *American Journal of Sports Medicine*. 1992; 20:717–24. [PubMed: 1456366]
- Bahrke MS, Yesalis CE. Abuse of anabolic androgenic steroids and related substances in sport and exercise. *Current Opinions in Pharmacology*. 2004; 4:614–20.
- Bhasin S, Storer TW, Berman N, Callegari C, Clevenger B, Phillips J, Casaburi R, et al. The effects of supraphysiologic doses of testosterone on muscle size and strength in normal men. *New England Journal of Medicine*. 1996; 335:1–7. [PubMed: 8637535]
- Birzniece V, Nelson AE, Ho KK. Growth hormone administration: is it safe and effective for athletic performance. *Endocrinology and Metabolism Clinics of North America*. 2010; 39:11–23. vii. [PubMed: 20122446]
- Blouin AG, Goldfield GS. Body image and steroid use in male bodybuilders. *International Journal of Eating Disorders*. 1995; 18:159–65. [PubMed: 7581418]
- Brower KJ, Eliopoulos GA, Blow FC, Catlin DH, Beresford TP. Evidence for physical and psychological dependence on anabolic androgenic steroids in eight weight lifters. *American Journal of Psychiatry*. 1990; 147:510–2. [PubMed: 2316741]
- Brower KJ, Blow FC, Young JP, Hill EM. Symptoms and correlates of anabolic-androgenic steroid dependence. *British Journal of Addiction*. 1991; 86:759. [PubMed: 1878625]
- Buss AH, Perry M. The aggression questionnaire. *Journal of Personality and Social Psychology*. 1992; 63:452–9. [PubMed: 1403624]
- Copeland J, Peters R, Dillon P. Anabolic-androgenic steroid use disorders among a sample of Australian competitive and recreational users. *Drug and Alcohol Dependence*. 2000; 60:91–6. [PubMed: 10821993]
- Cororve MB, Gleaves DH. Body dysmorphic disorder: a review of conceptualizations, assessment, and treatment strategies. *Clinical Psychology Review*. 2001; 21:949–70. [PubMed: 11497214]
- Crowne DP, Marlowe D. A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology*. 1960; 24:349–54. [PubMed: 13813058]
- De Coverley Veale DM. Exercise dependence. *British Journal of Addiction*. 1987; 82:735–40. [PubMed: 3311101]
- Derogatis, LR. SCL-90-R: Administration, scoring and procedures manual for the R(evised) version of the Symptom Checklist. Baltimore, MD: John Hopkins University, School of Medicine; 1977.
- Evans NA. Gym and tonic: a profile of 100 male steroid users. *British Journal of Sports Medicine*. 1997; 31:54–8. [PubMed: 9132214]
- Evans NA. Current concepts in anabolic-androgenic steroids. *American Journal of Sports Medicine*. 2004; 32:534–42. [PubMed: 14977687]
- Fairburn CG, Beglin SJ. Assessment of eating disorders: interview or self-report questionnaire? *International Journal of Eating Disorders*. 1994; 16:363–70. [PubMed: 7866415]
- Fineberg NA, Potenza MN, Chamberlain SR, Berlin HA, Menzies L, Bechara A, et al. Probing compulsive and impulsive behaviors, from animal models to endophenotypes: a narrative review. *Neuropsychopharmacology*. 2010; 35(3):591–604. [PubMed: 19940844]
- First, MB.; Spitzer, RL.; Gibbon, M.; Williams, JBW. Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Non-patient Edition. New York: Biometrics REsearch, New York State Psychiatric Institute; 2007.
- Frisch H. Growth hormone and body composition in athletes. *Journal of Endocrinological Investigation*. 1999; 22:106–9. [PubMed: 10442579]
- Geyer H, Parr MK, Koehler K, Mareck U, Schanzer W, Thevis M. Nutritional supplements cross-contaminated and faked with doping substances. *Journal of Mass Spectrometry*. 2008; 43:892–902. [PubMed: 18563865]

- Goldfarb AH, Jamurtas AZ. Beta-endorphin response to exercise: An update. *Sports Medicine*. 1997; 24:8–16. [PubMed: 9257407]
- Goldfield GS, Blouin AG, Woodside DB. Body image, binge eating, and bulimia nervosa in male bodybuilders. *Canadian Journal of Psychiatry*. 2006; 51:160–8.
- Grant JE, Potenza MN. Compulsive aspects of impulse-control disorders. *Psychiatric Clinics of North America*. 2006; 29(2):539–551. [PubMed: 16650722]
- Greiner M, Pfeiffer D, Smith RD. Principles and practical application of the receiver-operating characteristic analysis for diagnostic tests. *Preventive Veterinary Medicine*. 2000; 45:23–41. [PubMed: 10802332]
- Gruber AJ, Pope HG Jr. Psychiatric and medical effects of anabolic-androgenic steroid use in women. *Psychotherapy and Psychosomatics*. 2000; 69:19–26. [PubMed: 10601831]
- Guidi J, Pender M, Hollon SD, Zisook S, Schwartz FH, Petersen TJ, et al. The prevalence of compulsive eating and exercise among college students: an exploratory study. *Psychiatry Research*. 2009; 165:154–62. [PubMed: 19046604]
- Hall RCW, Chapman MJ. Psychiatric complications of anabolic steroid abuse. *Psychosomatics*. 2005; 46:285–290. [PubMed: 16000671]
- Hamer M, Karageorghis CI. Psychobiological mechanisms of exercise dependence. *Sports Medicine*. 2007; 37:477–84. [PubMed: 17503874]
- Hartgens F, Kuipers H. Effects of androgenic-anabolic steroids in athletes. *Sports Medicine*. 2004; 34:513–54. [PubMed: 15248788]
- Hauck ER, Blumenthal JA. Obsessive and compulsive traits in athletes. *Sports Medicine*. 1992; 14:215–27. [PubMed: 1475551]
- Hildebrandt T, Lai J, Langenbucher JW, Schneider M, Yehuda R, Pfaff DW. The diagnostic dilemma of pathological appearance and performance enhancing drug use. *Drug and Alcohol Dependence*. 2010 Epub November 4, 2010.
- Hildebrandt T, Langenbucher J, Schlundt DG. Muscularity concerns among men: development of attitudinal and perceptual measures. *Body Image*. 2004; 1:169–81. [PubMed: 18089149]
- 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 Behavior*. 2006; 20:234–40.
- Hildebrandt T, Schlundt D, Langenbucher J, Chung T. Presence of muscle dysmorphia symptomatology among male weightlifter. *Comprehensive Psychiatry*. 2006; 47:127–135. [PubMed: 16490571]
- 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; 116:717–33. [PubMed: 18020718]
- Hildebrandt T, Walker DC, Alfano L, Delinsky S, Bannon K. Development and validation of a male specific body checking questionnaire. *International Journal of Eating Disorders*. 2009; 43:77–87. [PubMed: 19247988]
- Hildebrandt T, Alfano L, Langenbucher J. Body image disturbance among 1000 appearance and performance enhancing drug users. *Journal of Psychiatric Research*. 2010; 44:841–6. [PubMed: 20110092]
- Hoffman JR, Kraemer WJ, Bhasin S, Storer T, Ratamess NA, Haff GG, Rogol AD, et al. Position stand on androgen and human growth hormone use. *Journal of Strength & Conditioning Research*. 2009; 23:S1–S59. [PubMed: 19620932]
- Hurst R, Hale B, Smith D, Collins D. Exercise dependence, social physique anxiety, and social support in experienced and inexperienced bodybuilders and weightlifters. *British Journal of Sports Medicine*. 2000; 34:431–5. [PubMed: 11131230]
- Kanayama G, Pope HG, Cohane G, Hudson JI. Risk factors for anabolic-androgenic steroid use among weightlifters: a case-control study. *Drug and Alcohol Dependence*. 2003; 71:77–86. [PubMed: 12821208]
- Kanayama G, Barry S, Hudson JI, Pope HG. Body image and attitudes toward male roles in anabolic-androgenic steroid users. *American Journal of Psychiatry*. 2006; 163:697–703. [PubMed: 16585446]

- Kanayama G, Boynes M, Hudson JI, Field AE, Pope HG Jr. Anabolic steroid abuse among teenage girls: an illusory problem? *Drug and Alcohol Dependence*. 2007; 88:156–62. [PubMed: 17127018]
- Kanayama G, Hudson JI, Pope HG. Long-term psychiatric and medical consequences of anabolic-androgenic steroid use: A looming public health concern? *Drug and Alcohol Dependence*. 2008; 98:1–12. [PubMed: 18599224]
- Kanayama G, Brower KJ, Wood RI, Hudson JI, Pope HG. Anabolic-androgenic steroid dependence: an emerging disorder. *Addiction*. 2009a; 104:1966–1978. [PubMed: 19922565]
- Kanayama G, Brower KJ, Wood RI, Hudson JI, Pope HG. Issues for DSM-V: Clarifying the Diagnostic Criteria for Anabolic-Androgenic Steroid Dependence. *American Journal of Psychiatry*. 2009b; 166:642–644. [PubMed: 19487399]
- Kanayama G, Brower KJ, Wood RI, Hudson JI, Pope HG Jr. Anabolic-Androgenic Steroid Dependence: An Emerging Disorder. *Addiction*. 2009c; 104:1966–1978. [PubMed: 19922565]
- Kanayama G, Hudson JI, Pope HG. Features of men with anabolic-androgenic steroid dependence: A comparison with nondependent AAS users and with AAS nonusers. *Drug and Alcohol Dependence*. 2009a; 102:130–137. [PubMed: 19339124]
- Kanayama G, Hudson JI, Pope HG Jr. Illicit anabolic-androgenic steroid use. *Hormones and Behavior*. 2009b; 1:111–21.
- Kashkin KB, Kleber HD. Hooked on hormones? An anabolic steroid addiction hypothesis. *Journal of the American Medical Association*. 1989; 262:3166–70. [PubMed: 2681859]
- Kazlauskas R. Designer steroids. *Handbook of Experimental Pharmacology*. 2010; 195:155–85. [PubMed: 20020364]
- Kurling S, Kanakaapaa A, Seppala T. Sub-chronic nandrolone treatment modifies neurochemical and behavioral effects of amphetamine and 3,4-methylenedioxymethamphetamine (MDMA) in rats. *Behavioural Brain Research*. 2008; 189:191–201. [PubMed: 18261810]
- Lambert CP, Frank LL, Evans WJ. Macronutrient considerations for the sport of bodybuilding. *Sports Medicine*. 2004; 34:317–27. [PubMed: 15107010]
- Linden A. Measuring diagnostic and predictive accuracy in disease management: an introduction to receiver operating characteristic (ROC) analysis. *Journal of Evaluation in Clinical Practice*. 2006; 12:132–9. [PubMed: 16579821]
- Lindstrom M, Nilsson AL, Katzman PL, Janzon L, Dymling JF. Use of anabolic-androgenic steroids among body builders--frequency and attitudes. *Journal of Internal Medicine*. 1990; 227:407–11. [PubMed: 2351927]
- Mangweth B, Pope HG Jr, Kemmler G, Ebenbichler C, Hausmann A, De Col C, Biele W, et al. Body image and psychopathology in male bodybuilders. *Psychotherapy and Psychosomatics*. 2001; 70:38–43. [PubMed: 11150937]
- Mathes WF, Nehrenberg DL, Gordon R, Hua K, Garland T, Pomp D. Dopaminergic dysregulation in mice selectively bred for excessive exercise or obesity. *Behavioural Brain Research*. 2010; 210:155–63. [PubMed: 20156488]
- Martello S, Felli M, Chiarotti M. Survey of nutritional supplements for selected illegal anabolic steroids and ephedrine using LC-MS/MS and GC-MS methods, respectively. *Food Additives & Contaminants*. 2007; 24:258–65. [PubMed: 17364927]
- Martinez-Sanchis S, Aragon CM, Salvador A. Cocaine-induced locomotor activity is enhanced by exogenous testosterone. *Physiology & Behavior*. 2002; 76:605–9. [PubMed: 12126999]
- Midgley SJ, Heather N, Davies JB. Levels of aggression among a group of anabolic-androgenic steroid users. *Medicine, Science, & the Law*. 2001; 41:309–14.
- Millman RB, Ross EJ. Steroid and nutritional supplement use in professional athletes. *American Journal of Addiction*. 2003; 12(Suppl 2):S48–54.
- Molnar D, Torok K, Erhardt E, Jeges S. Safety and efficacy of treatment with an ephedrine/caffeine mixture: The first double-blind placebo-controlled pilot study in adolescents. *International Journal of Obesity and Related Metabolic Disorders*. 2000; 24:1573–8. [PubMed: 11126208]
- Monaghan LF. Vocabularies of motive for illicit steroid use among bodybuilders. *Social Science and Medicine*. 2002; 55:695–708. [PubMed: 12190264]

- 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; 21:551–62. [PubMed: 16356691]
- Parkinson AB, Evans NA. Anabolic androgenic steroids: A survey of 500 users. *Medicine and Science in Sports and Exercise*. 2006; 38:644–651. [PubMed: 16679978]
- Patton JH, Stanford MS, Barratt ES. Factor structure of the Barratt impulsiveness scale. *Journal of Clinical Psychology*. 1995; 51:768–74. [PubMed: 8778124]
- Perry PJ, Lund BC, Deninger MJ, Kutscher EC, Schneider J. Anabolic steroid use in weightlifters and bodybuilders: an internet survey of drug utilization. *Clinical Journal of Sports Medicine*. 2005; 15:326–30.
- Petersson A, Garle M, Granath F, Thiblin I. Morbidity and mortality in patients testing positively for the presence of anabolic androgenic steroids in connection with receiving medical care. A controlled retrospective cohort study. *Drug and Alcohol Dependence*. 2006; 81:215–20. [PubMed: 16125336]
- Petersson A, Garle M, Holmgren P, Druid H, Krantz P, Thiblin I. Toxicological findings and manner of death in autopsied users of anabolic androgenic steroids. *Drug and Alcohol Dependence*. 2006; 81:241–9. [PubMed: 16137840]
- Petersson A, Bengtsson J, Voltaire-Carlsson A, Thiblin I. Substance abusers' motives for using anabolic androgenic steroids. *Drug and Alcohol Dependence*. 2010; 111:170–172. [PubMed: 20483546]
- Philips KA, Hollander E, Rasmussen SA, Aronwitz BR, DeCaria C, Goodman WK. A severity rating scale for body dysmorphic disorder: development, reliability, and validity of a modified version of the Yale-Brown Obsessive Compulsive Scale. *Psychopharmacological Bulletin*. 1997; 33:17–22.
- Pickett TC, Lewis RJ, Cash TF. Men, muscles, and body image: comparisons of competitive bodybuilders, weight trainers, and athletically active controls. *British Journal of Sports Medicine*. 2005; 39:217–22. discussion 217–22. [PubMed: 15793091]
- Pope HG Jr, Katz DL. Psychiatric and medical effects of anabolic-androgenic steroid use. A controlled study of 160 athletes. *Archives of General Psychiatry*. 1994; 51:375–82. [PubMed: 8179461]
- Pope HG Jr, Gruber AJ, Choi P, Olivardia RR, Philips KA. Muscle dysmorphia. An underrecognized form of body dysmorphic disorder. *Psychosomatics*. 1997; 38:548–57. [PubMed: 9427852]
- Pope HG, Kanayama G, Ionescu-Pioggia M, Hudson JI. Anabolic steroid users' attitudes towards physicians. *Addiction*. 2004; 99:1189–1194. [PubMed: 15317640]
- Reas DL, Whisenhunt BL, Netemeyer R, Williamson DA. Development of the body checking questionnaire: a self-report measure of body checking behaviors. *International Journal of Eating Disorders*. 2002; 31:324–33. [PubMed: 11920995]
- Samenuk D, Link MS, Homoud MK, Contreras R, Theoharides TC, Wang PJ, Estes NA. Adverse cardiovascular events temporally associated with ma huang, an herbal source of ephedrine. *Mayo Clinic Proceedings*. 2002; 77:12–16. [PubMed: 11795249]
- Segal DL, Hersen M, Van Hasselt VB. Reliability of the Structured Clinical Interview for DSM-III-R: an evaluative review. *Comprehensive Psychiatry*. 1994; 35:316–27. [PubMed: 7956189]
- Shahidi NT. A review of the chemistry, biological action, and clinical applications of anabolic-androgenic steroids. *Clinical Therapeutics*. 2001; 23:1355–1390. [PubMed: 11589254]
- Skarberg K, Nyberg F, Engstrom I. Multisubstance use as a feature of addiction to anabolic-androgenic steroids. *European Addiction Research*. 2009; 15:99–106. [PubMed: 19182484]
- Smith D, Hale B. Exercise-dependence in bodybuilders: antecedents and reliability of measurement. *Journal of Sports Medicine and Physical Fitness*. 2005; 45:401–8. [PubMed: 16230993]
- Trenton AJ, Currier GW. Behavioural manifestations of anabolic steroid use. *CNS Drugs*. 2005; 19:571–595. [PubMed: 15984895]
- Urhausen A, Albers T, Kindermann W. Are the cardiac effects of anabolic steroid abuse in strength athletes reversible? *Heart*. 2004; 90:496–501. [PubMed: 15084541]
- van den Heuvel OA, van der Werf YD, Verhoef KM, de Wit S, Berendse HW, Wolters E, et al. Frontal-striatal abnormalities underlying behaviours in the compulsive-impulsive spectrum. *Journal of Neurological Science*. 2010; 289(1-2):55–59.

- Walker DC, Anderson DA, Hildebrandt T. Body checking behaviors in men. *Body Image*. 2009; 6:164–170. [PubMed: 19482568]
- Weissman MM, Bothwell S. Assessment of social adjustment by patient self-report. *Archives of General Psychiatry*. 1976; 33:1111–5. [PubMed: 962494]
- Wood RI. Oral testosterone self-administration in male hamsters: dose-response, voluntary exercise, and individual differences. *Hormones and Behavior*. 2002; 41:247–58. [PubMed: 11971658]
- Wood RI. Reinforcing aspects of androgens. *Physiology & Behavior*. 2004; 83:279–89. [PubMed: 15488545]
- Wood RI. Anabolic-androgenic steroid dependence? Insights from animals and humans. *Frontiers in Neuroendocrinology*. 2008; 29:490–506. [PubMed: 18275992]
- Woodhouse LJ, Gupta N, Bhasin M, Singh AB, Ross R, Phillips J, Bhasin S. Dose-dependent effects of testosterone on regional adipose tissue distribution in healthy young men. *Journal of Clinical Endocrinology & Metabolism*. 2004; 89:718–26. [PubMed: 14764787]
- Woodhouse LJ, Reisz-Porszasz S, Javanbakht M, Storer TW, Lee M, Zerounian H, Bhasin S. Development of models to predict anabolic response to testosterone administration in healthy young men. *American Journal of Physiology - Endocrinology And Metabolism*. 2003; 284:E1009–17. [PubMed: 12517741]

Research Highlights

- The Appearance and Performance Enhancing Drug Use Schedule (APEDUS) is the first standardized assessment of the drug use patterns, impairment, and associated psychological features.
- The APEDUS has strong evidence for inter-rater and test-retest reliability
- The APEDUS subscales have strong convergent and construct validity and are sensitive and specific to the measure of anabolic steroid dependence
- APED users are accurate self-reporters of the APEDs they use

Table 1

Summary of Participant Demographics by Recruitment Site

	MSSM (<i>n</i> = 44)	Rutgers (<i>n</i> = 41)
Age	41.49 (8.90) ^a	23.81 (6.35)
Gender (percent male)	70.9%	88.4%
BMI	29.08 (4.91) ^a	26.67 (4.06)
Body Fat Percentage	13.78% (6.70)	11.05% (7.07)
Income	79,072 (62,461) ^a	30,326 (47,902)
Years of Education	15.30 (2.00)	14.60 (1.38)
Marital status ^b		
Single	44.2%	90.7%
Divorced	11.6%	--
Separated	9.3%	--
Living as Married	7.0%	2.3%
Married	27.9%	6.7%
Employment ^b		
Full-Time	67.4%	6.0%
Part-Time	23.3%	23.3%
Student	2.3%	55.8%
Retired	2.3%	--
Unemployed	2.3%	4.7%
Disabled	--	2.3%
Race/Ethnicity ^b		
White	42.5%	67.4%
African American or Black	15.0%	16.3%
American Indian or Alaskan Native	2.5%	--
Asian	2.5%	11.6%
Hispanic or Latino	37.5%	4.7%
Sexual Orientation		
Primarily Heterosexual	74.4%	90.7%
Primarily Homosexual	18.6%	4.7%
Bisexual	7.0%	4.7%

Note. MSSM = Mount Sinai School of Medicine.

^a analysis of variance significant at $p < .001$.

^b chi-square significant at $p < .001$.

Mean and standard deviation reported for continuous variables.

Table 2

Summary of APEDUS Modules and Content

Module	Module Number	Number of Items	Content
Background and Demographics		32	Basic information about anthropometrics, age, occupation, income, relationship status, sexuality, health status and familial risk, and health service engagement.
Training History & Identity (Compulsive Exercise Subscale)	I	15	Basic information about investment, type, quantity, and frequency of exercise and its history. It includes a 10-item subscale that measures the degree to which one is preoccupied with exercise, is compulsive or out of control of exercise, and is sensitive to the rewarding properties of exercise.
Dietary History & Practices (Dietary Control Subscale)	II	19	Basic information about dietary practices, macronutrient control, and dieting history. The 12-item Dietary Control subscale measures preoccupation with diet or food, compulsive or perfectionistic nature of rules and dietary control, and loss of control over eating or sensitivity to rewarding properties of food.
Body Image and Appearance Control (Body Image Disturbance Subscale)	III	11	Basic information about investment in appearance or body control. Measures preoccupation, compulsive body evaluation, loss of control over appearance controlling behavior, and positive feelings associated with appearance.
Nutritional Supplements and Pro-hormone Use	IV	33	Basic information on history, types, and influences over choice to use substances. Categorizes into supplements, fat burners, and pro-hormones.
First APED Cycle	V	35 ^a	Information about age and influences over cycle initiation, specific substances used and their dosage, duration, and maximum doses. Physical and psychological changes, benefits, and side effects (on-cycle and post-cycle) of the APED cycle as well as satisfaction with cycle effects.
Current/Most Recent APED Cycle	VI	38 ^a	Information about cycle initiation, current cycle status, and timing of cycle conclusion. Same questions about referenced APED cycle as is queried in Module V.
Usual APED Cycle	VII	5 ^a	Information about number of cycles and duration between cycles, common sources of influence, and summary of the types of substances used during an APED cycle.
Social Context of APED Use	VIII	7	Information about the degree to one is connected to a community of APED users and relies on them for information and to source APEDs.
Risk and Future Use	IX	15	Information about investment in APEDs over other types of drugs or continued use despite experiencing certain types of consequences of APED use.

Note. APEDUS = Appearance and Performance Enhancing Drug Use Schedule.

^a Appendices used in conjunction with interview to facilitate accurate responding.

Table 3

Summary of APED Use Phenomena

	First APED Cycle	Current/Most Recent Cycle	Usual APED Cycle
Age	26.75 (9.82)		
Primary Influence	54.7% Friend or Family	78.1% Independent	72.1% Independent
On-Cycle Side Effects			
Physical Side Effects	.24 (.25)	.24 (.34)	
Sexual Side Effects	.13 (.19)	.18 (.30)	
Mood and Affect Effects	.41 (.52)	.47 (.68)	
Cognitive Effects	.17 (.41)	.09 (.23)	
Unwanted Changes to Appearance	.05 (.10)	.06 (.11)	
Medical Consequences	.04 (.09)	.05 (.11)	
Administration Related Side Effects	.05 (.13)	.05 (.14)	
Post Cycle Side Effects	.27 (.40)	.23 (.31)	
Number of Illicit APEDs	1.77 (1.28)	2.15 (1.90)	
Ancillary Drugs	1.44 (.87)	2.07 (1.55)	
Nutritional Supplements (general)		78.4%	
Nutritional Supplements (fat burning/ endurance)		34.3%	
Nutritional Supplements (prohormones)		27.9%	
Benefits	2.00 (.95)	1.70 (.97)	
Cycle Length in days		68.82 (68.45)	
Average Dose of AAS mg/week	417.58 (902.81)	821.81 (1244.74)	
Strength Increase	57.94% (111.35)	31.37% (32.94)	
Weight Change	16.25 (60.44)	8.07 (11.51)	
Body Fat Percentage	11.90 (5.55)	14.83 (8.26)	
Costs of Cycle	200.00 ^a (2834.32)	200.00 ^a (2683.57)	
Number of Cycles			11.90 (24.25)
Weeks between Cycles			13.53 (24.56)

Note. APED = Appearance and Performance Enhancing Drug Use.

^a median reported.

Table 4

Summary of Reliability Coefficients for APEDUS Modules

Module	α	Inter-rater Reliability		Test-Retest Reliability	
		Scale	Items	Scale	Items
Background and Demographics			.89-1.0		.91-1.0
Training History & Identity (Compulsive Exercise Subscale)	.88	.81	.76-1.0	.83	.79-1.0
Dietary History & Practices (Dietary Control Subscale)	.84	.88	.82-1.0	.81	.76-1.0
Body Image and Appearance Control	.89	.84	.79-.10	.89	.77-1.0
Nutritional Supplements and Pro-hormone Use					
Supplements			.94-1.0		.82-1.0
Over-the-Counter Fat Burners			.94-1.0		.84-1.0
Prohormones			.96-1.0		.85-1.0
First APED Cycle					
Benefits	.87	.95	.90-1.0	.88	.82-1.0
Physical Side Effects	.79	.91	.69-1.0	.77	.70-1.0
Cognitive Side Effects	.69	.90	.80-1.0	.79	.70-1.0
Sexual Side Effects	.88	.94	.88-1.0	.84	.76-1.0
Mood and Affect Side Effects	.91	.92	.89-1.0	.85	.74-1.0
Unwanted Changes to Appearance	.88	.96	.92-1.0	.82	.77-1.0
Medical Side Effects	.76	.96	.92-1.0	.80	.66-1.0
Post-Cycle Side Effects	.81	.90	.88-1.0	.79	.69-1.0
Current/Most Recent APED Cycle					
Benefits	.87	.96	.91-1.0	.83	.72-1.0
Physical Side Effects	.82	.92	.74-1.0	.80	.70-1.0
Cognitive Side Effects	.85	.90	.81-1.0	.79	.68-1.0
Sexual Side Effects	.81	.90	.86-1.0	.80	.71-1.0
Mood and Affect Side Effects	.89	.92	.87-1.0	.87	.76-1.0
Unwanted Changes to Appearance	.88	.90	.87-1.0	.84	.69-1.0
Medical Side Effects	.77	.88	.84-1.0	.84	.71-1.0
Post-Cycle Side Effects	.78	.94	.92-1.0	.76	.66-1.0

Module	α	Inter-rater Reliability		Test-Retest Reliability	
		Scale	Items	Scale	Items
Usual APED Cycle					
Social Context of APED Use	.72	.84	.78-1.0	.77	.67-1.0
Risk and Future Use	.93 ^a	.89	.86-1.0	.95	.92-1.0

Note. APEDUS = Appearance and Performance Enhancing Drug Use Schedule.

^a Kuder-Richardson-20 coefficient used because of dichotomously scored items. Scale inter-rater reliability reflects interclass correlation coefficient.

Table 5

Summary of Multiple Regression Coefficients for Measures of Convergent Validity for APEDUS Subscales

APEDUS Subscale (IV)	Convergent or Divergent Measure (DV)	β	Adjusted R^2
Compulsive Exercise			
	MDDI-Functional Impairment	.571**	.311
	Quantity $\times$ Frequency of Exercise	.184*	.029
	MCSDS	-.193	.018
Dietary Control			
	EDE-Q-Eating Concern Subscale	.203*	.048
	Restraint Subscale	.027	.001
	MCSDS	-.094	.009
Body Image and Appearance Control			
	EDE-Q -Shape Concern	.337**	.114
	EDE-Q-Weight Concern	.147	.017
	MDDI-Total	.311**	.097
	MBCQ-Total	.373**	.128
	BCQ-Total	.313**	.098
	YBOCS-BDD Total	.453**	.208
	MCSDS	-.137	.011
Risk and Future Use			
	Number of APED Cycles	.027	.001
	Average Duration of Cycle	.198*	.023
	Number of APEDs	.356**	.059
	WSAS	.199*	.041
	MCSDS	.045	.001
Current Mood and Affect Side Effects			
	SCL-90	.286*	.056
	BIS-Total	.225*	.038
	BP-Aggression	.256*	.049
	WSAS	.112	.004
	MCDS	-.020	.000
Current Global Side Effect Severity			
	SCL-90	.153	.007
	BIS-Total	.241**	.042
	BP-Aggression	.137	.002
	WSAS	.138	.002
	MCDS	.022	.001
Benefits			
	WSAS	.140	.003
	SCL-90	.262**	.053

APEDUS Subscale (IV)	Convergent or Divergent Measure (DV)	β	Adjusted R^2
	BIS-Total	.362**	.116
	BP-Aggression	.101	.003
	MCDS	-.034	-.016

Note. MDDI = Muscle Dysmorphic Disorder Inventory. MCSDS = Marlowe-Crown Social Desirability Scale. EDE-Q = Eating Disorder Examination Questionnaire. MBCQ = Male Body Checking Questionnaire. BCQ = Body Checking Questionnaire. SCL-90 = Symptom Checklist-90. BIS = Barratt Impulsivity Scale. BP-Aggression = Buss-Perry Aggression Questionnaire. WSAS = Work Social Adjustment Scale. YBOCS-BDD = Yale-Brown Obsessive-Compulsive Scale for Body Dysmorphic Disorder.