


# Characteristics and Attitudes of Men Using Anabolic Androgenic Steroids (AAS): A Survey of 2385 Men

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Alex K. Bonneau, MD<sup>1</sup> , Thomas O'Connor, MD<sup>2</sup>, and Joseph A. Aloia, MD<sup>1</sup>

## Abstract

Additional characterization of patients using anabolic androgenic steroids (AAS) is needed to improve harm reduction and cessation resources for patients. Our group sought to expand upon the currently limited data regarding AAS use by performing a web-based survey assessing experiences of males using AAS. Participants included men over the age of 18 with history of AAS use within the past 5 years. Data were collected between August 2019 and April 2020. Primary outcome measures included age when starting AAS, dose of AAS, motivations for use, experiences with health-care professionals, and rate of successful cessation. The survey was accessed 3640 times, resulting in 2385 completed surveys meeting the inclusion criteria (68.93% participation rate).

Average participant age was  $31.69 \pm 10.09$  years. Over half of respondents were from the United States ( $n = 1271$ , 53.3%). Motives to use AAS included improving appearance ( $n = 1959$ , 82.2%), strength gain ( $n = 1192$ , 50%), and self-esteem/body image issues ( $n = 712$ , 29.87%). Participants rated physicians poorly, regarding knowledge of AAS ( $4.08 \pm 2.23$ ). Most participants did not reveal AAS use to their health-care providers ( $n = 1338$ , 56.1%); of those that did, 55.30% ( $n = 579$ ) reported feeling discriminated against for their use. Of 46.16% ( $n = 1101$ ) attempting AAS cessation, 60.22% ( $n = 663$ ) were unsuccessful. Challenges in the management of AAS use include early onset of use, supraphysiologic doses used, and frequently present body image disorders stress. Distrust of health-care providers, poor cessation rates, and lack of physician training further exacerbate this. These findings should serve to reinforce previous calls to action for further research on the treatment of AAS use disorder.

## Keywords

anabolic steroid use, anabolic androgenic steroids, androgen abuse

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The widespread adoption of anabolic androgenic steroid (AAS) use has exacerbated an emerging worldwide public health epidemic. The true lifetime prevalence of AAS use is difficult to establish, but conservative estimates range from 1% to 5% worldwide and are higher in the United States (Anawalt, 2019). Increasing social acceptance of use, ease of acquisition through the internet (Fink et al., 2019), and a growing preoccupation with male appearance fueled by social media (Pope et al., 2017) are believed to be contributing factors. These drugs have multisystem effects, and often severe withdrawal symptoms can impede cessation. Men using AAS often hesitate to seek out physicians for help, viewing them as both unknowledgeable on AAS and disrespectful to those taking these substances (Pope et al., 2004; Zahnow et al.,

2017). Instead, these patients default to friends, online forums, and self-proclaimed coaches or gurus for advice that is often inaccurate and dangerous (de Ronde & Smit, 2020; Fink et al., 2019). A 2019 review highlights the

<sup>1</sup>School of Medicine, Department of Internal Medicine, Section on Endocrinology and Metabolism, Wake Forest University, Winston-Salem, NC, USA

<sup>2</sup>Department of Internal Medicine, University of Connecticut School of Medicine, Farmington, CT, USA

## Corresponding Author:

Alex K. Bonneau MD, School of Medicine, Department of Internal Medicine, Section on Endocrinology and Metabolism, Wake Forest University, 1 Medical Center Blvd, Winston-Salem, NC 27157, USA.  
Email: [Abonneca@wakehealth.edu](mailto:Abonneca@wakehealth.edu)



lack of data, guidelines, and clinical preparedness to assist these patients (Goldman et al.).

The lack of larger comprehensive studies makes the reliability of the AAS using patient profile problematic. A more complete characterization of this population is needed to design patient-centered medical protocols for harm minimization and successful cessation. Thus, we sought to assess a broad number of characteristics of AAS use via a large-scale online survey study, designed to test the reliability of prior findings while also exploring questions suggested by these and the authors' clinical experiences.

### *Anabolic Androgenic Steroids: The State of the Art*

The primary classes of AAS consist of testosterone esters, 19-nortestosterone derivatives, and dihydrotestosterone (DHT) derivatives (Kicman, 2008; Llewellyn, 2017). Direct hepatotoxicity is only seen with 17-alpha alkylated oral AAS (Niedfeldt, 2018). Commonly used accessory performance enhancing drugs (PEDs) include aromatase inhibitors (AIs), selective estrogen receptor modulators (SERMs), human chorionic gonadotropin (hCG), thyroid hormone, insulin, and human growth hormone (hGH), among others (de Ronde & Smit, 2020). AIs and SERMs (particularly tamoxifen) are used to mitigate the estrogenic side effects of supraphysiologic androgen levels, while hCG is used to maintain testicular volume (Anawalt, 2019). Many men using AAS utilize the SERM clomiphene and/or hCG while temporarily stopping AAS in an attempt to normalize the hypothalamic-pituitary-testicular (HPT) axis (Anawalt, 2019; de Ronde & Smit, 2020; Smit & de Ronde, 2018; Smit et al., 2020), a practice commonly known as "post-cycle therapy" or "PCT."

While long-term prospective harm data are lacking, strong evidence exists for the development of accelerated atherosclerosis, left ventricular hypertrophy, arrhythmias, hypertension, and HDL suppression (Achar et al., 2010; Alizade et al., 2016; Baggish et al., 2017; Santora et al., 2006; Thiblin et al., 2015). Polycythemia, infertility, tendon rupture of the upper extremity, and behavioral disorders are commonly associated with AAS use (Coviello et al., 2008; Hauger et al., 2019; Kanayama, DeLuca, et al., 2015; Rahnema et al., 2014; Tatem et al., 2019; Thiblin et al., 1999). AAS withdrawal syndrome has also been reported and is due to the sudden decline in androgen levels with resultant anabolic steroid-induced hypogonadism (ASIH) and neuropsychiatric effects (Bertozzi et al., 2019; Bhasin et al., 2018; Pope et al., 2014). Prolonged hypogonadism after AAS cessation has been well described, due to direct testicular toxicity from chronic exposure to very high dose androgen levels (Chainy et al., 1997; Kanayama, Hudson, et al., 2015; Rasmussen et al., 2016).

Approaches to transitioning men from AAS have been proposed (Anawalt, 2019; Rahnema et al., 2014), such as supervised tapering of testosterone dosage or the use of hCG or clomiphene citrate. However, no randomized control trials or prospective data exist to support these approaches. The net result is a growing population of patients using AAS with limited to no medical resources to assist with attempted cessation.

### **Methods**

An anonymous web-based survey consisting of 160 items, intended to take 20 min to complete, was designed using REDCap electronic data capture tools (Harris et al., 2009, 2019). Questions were designed based on the authors' clinical experience in addition to existing evidence and consisted of primarily multiple-choice questions and numeric ratings. Several questions included the option to select multiple applicable responses. All related materials and methods were reviewed by the Wake Forest University IRB and approved (IRB00057901). The survey was advertised on nine AAS use web forums, and on one of the author's YouTube channel that focuses on patient education for AAS side effects and support for cessation (Thomas O'Connor). Upon clicking the survey link, participants were directed to a consent page where they were given the option to voluntarily participate, noting that they should only participate if they were comfortable disclosing details regarding AAS use. The potential to experience feelings of distress while discussing past experiences of abuse was noted. Inclusion criteria were male gender, over the age of 18 years old, and having used AAS in the past 5 years. Those who did not meet these criteria were re-directed to a site informing them they were ineligible to participate. Survey responses were collected from August 2019 to April 2020. Upon completion of data collection, the results were further analyzed using REDCap and Microsoft Excel. In addition to analyzing the responses of all meeting the inclusion criteria, further subgroup analysis was performed on those from the United States (USA), countries other than the United States (World), those 18–34 years old (Under 35), and those age 35 or older (Over 35).

### *Statistical Analysis*

For questions requiring a rated response of 1–10, descriptive statistics were utilized to obtain mean values and 95% confidence intervals for each subgroup. A single-variable ANOVA test was used to compare multiple groups with continuous variables for significance. Fisher's exact test and the  $\chi^2$  test were used to compare binary data between two groups and groups larger than

**Table 1.** Demographics and Motivations of Men Using AAS.

Age (Years)		All Participants, <i>n</i> = 2385 (%)				
18–21		308 (12.91)				
22–30		1022 (42.85)				
31–40		584 (24.49)				
41–50		337 (14.13)				
51+		134 (5.62)				
Race	All, <i>n</i> = 2384 (%)	USA, <i>n</i> = 1271 (%)	World, <i>n</i> = 1113 (%)	Under 35, <i>n</i> = 1676 (%)	Over 35, <i>n</i> = 708 (%)	<i>p</i> Value <sup>a</sup>
Caucasian/White	1991 (83.52)	1070 (84.19)	921 (82.75)	1383 (82.52)	608 (85.88)	.2909
Hispanic/Latino	193 (8.10)	150 (11.80)	43 (3.86)	147 (8.77)	46 (6.50)	<.0005
Asian	132 (5.54)	50 (3.93)	82 (7.37)	112 (6.68)	20 (2.82)	<.0005
Other	90 (3.78)	23 (1.81)	67 (6.02)	68 (4.06)	22 (3.11)	<.0005
Black/African American	59 (2.47)	40 (3.15)	19 (1.71)	34 (2.03)	25 (3.53)	.0448
Native American	33 (1.38)	23 (1.81)	10 (0.90)	21 (1.25)	12 (1.69)	.3643
Prefer not to answer	17 (0.71)	11 (0.87)	6 (0.54)	11 (0.66)	6 (0.85)	.8863
Pacific Islander	13 (0.55)	9 (0.71)	4 (0.36)	9 (0.54)	4 (0.56)	.8550
Motivation for AAS Use	All, <i>n</i> = 2384 (%)	Under 35, <i>n</i> = 1676 (%)	Over 35, <i>n</i> = 708 (%)	<i>p</i> Value <sup>a</sup>		
Improve physical appearance/gain muscle	1959 (82.17)	1389 (82.88)	570 (80.51)	.1780		
Improve strength	1192 (50)	895 (53.40)	297 (41.95)	<.0001		
Issues with self-esteem regarding body image	712 (29.87)	569 (33.95)	143 (20.20)	<.0001		
Bodybuilding/Physique competitions	472 (19.80)	378 (22.55)	94 (13.28)	<.0001		
Other	300 (12.58)	181 (10.80)	119 (16.81)	<.0001		
Performance in organized athletics	219 (9.19)	161 (9.61)	58 (8.19)	.3130		
Peer pressure	54 (2.27)	46 (2.74)	8 (1.13)	.0153		
History of being sexually abused	15 (0.63)	9 (0.54)	6 (0.85)	.4003		
Reasons for Not Stopping AAS	All, <i>n</i> = 2385 (%)	Under 35, <i>n</i> = 1677 (%)	Over 35, <i>n</i> = 708 (%)	<i>p</i> Value <sup>a</sup>		
Fear of decreased overall quality of life	1167 (48.93)	742 (44.25)	424 (59.89)	<.0001		
Fear of losing muscle mass/worsened appearance	937 (39.29)	642 (38.28)	295 (41.67)	.1300		
Decreased strength/athletic performance	799 (33.50)	548 (32.68)	251 (35.45)	.1999		
N/A: I plan on eventually stopping AAS	709 (29.73)	576 (34.35)	133 (18.79)	<.0001		
Other	415 (17.40)	278 (16.58)	137 (19.35)	.1104		
Lack of medical support for patients on AAS who wish to stop using	339 (14.21)	235 (14.01)	104 (14.69)	.6539		
AAS withdrawal syndrome	247 (10.36)	167 (9.96)	80 (11.30)	.3392		
AAS addiction	142 (5.95)	109 (6.50)	33 (4.66)	.0885		

Note. <sup>a</sup>Under 35 versus Over 35. AAS = anabolic androgenic steroid.

two, respectively. For all statistical testing, a *p* value of <.05 was considered significant.

## Results

### Demographics, Motivations, and Acquisition

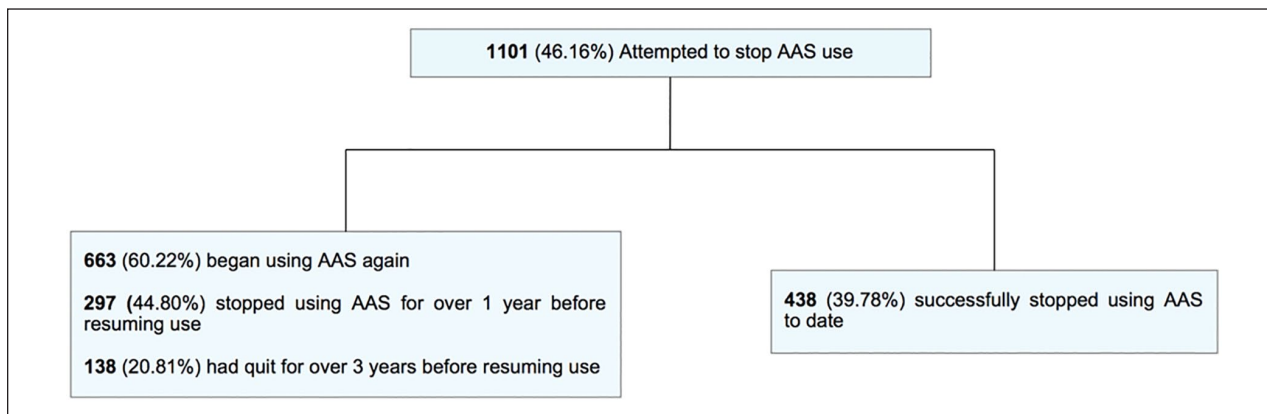
The survey was accessed 3640 times, resulting in 2385 completed surveys meeting the inclusion criteria (68.93%

participation rate). The average man using AAS was 31.69 ± 10.09 years old (Table 1). Men aged 22–30 represented 42.85% (*n* = 1022) of respondents. The most common ethnicity was Caucasian (*n* = 1991, 83.52%). Most respondents were from the United States (*n* = 1271, 53.3%). Other regions represented were Europe (*n* = 536, 22.47%), Canada (*n* = 198, 8.30%), and Australia/New Zealand (*n* = 134, 5.62%; Table 2).

**Table 2.** Countries of Respondents.

Country/Region	All, <i>n</i> = 2385 (%)	Under 35, <i>n</i> = 1677 (%)	Over 35, <i>n</i> = 708 (%)	<i>p</i> Value <sup>a</sup>
United States	1271 (53.29)	818 (48.78)	453 (63.98)	<.0001
Europe	536 (22.47)	415 (24.75)	121 (17.09)	<.0001
Canada	198 (8.30)	143 (8.53)	55 (7.77)	.5704
Australia/New Zealand	134 (5.62)	97 (5.78)	37 (5.32)	.6275
Asia	54 (2.26)	47 (2.80)	7 (0.99)	.0061
Other	53 (2.22)	46 (2.74)	7 (0.99)	.0061
Africa	47 (2)	39 (2.33)	8 (1.13)	.0744
South America	41 (1.72)	29 (1.73)	12 (1.69)	1.000
Middle East	38 (1.59)	32 (1.91)	6 (0.85)	.0722
Mexico	13 (0.55)	11 (0.66)	2 (0.28)	.3671

Note. <sup>a</sup>Under 35 versus Over 35. AAS = anabolic androgenic steroid.

**Figure 1.** Attempted AAS cessation. AAS = anabolic androgenic steroid.

The primary motive in using AAS was improving appearance ( $n = 1959$ , 82.2%) and strength gain ( $n = 1192$ , 50%; Table 1). Men over 35 were less likely to use AAS for strength gain, self-esteem/body image issues, or body-building/physique competitions than men under 35 (41.9% vs. 20.2%), compared to those under 35 (53.4% vs. 33.9%, respectively). Self-esteem or body image issues were strongly reported ( $n = 712$ , 29.87%) as motivation for use. Less than 10% of respondents reported using AAS for competitive athletics. These motivations were consistent when comparing sub-cohorts across regions. The most commonly reported reasons for not discontinuing AAS use were concerns over decreased quality of life ( $n = 1167$ , 48.93%), muscle loss/worsened appearance ( $n = 937$ , 39.3%), and decreased strength/athletic performance ( $n = 799$ , 33.5%). Subjects over 35 years old were significantly less likely to consider stopping AAS use than those under 35 years old (18.8% and 34.4%, respectively).

The primary source of AAS was the internet ( $n = 1465$ , 61.41%). Of the 16.82% ( $n = 401$ ) who reported physicians as a source of AAS, 20.95% reported this as their only source. Moreover, 79.05% ( $n = 317$ ) of respondents

who listed physicians as a source of AAS reported also obtaining AAS from additional sources.

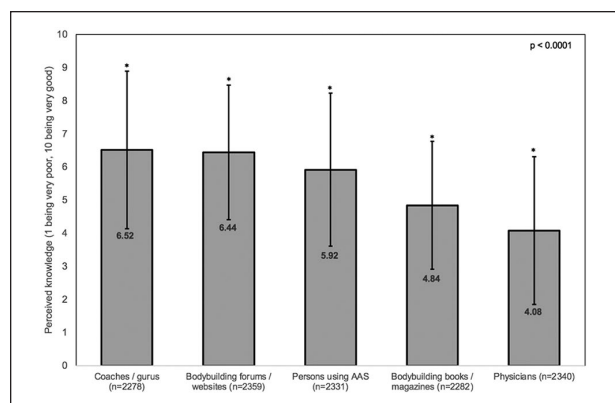
### Attempted AAS Cessation

Of 46.16% ( $n = 1101$ ) of participants who reported a prior attempt to stop AAS use, 39.78% ( $n = 438$ ) reported success (Figure 1). Of the 60.22% ( $n = 663$ ) who were unsuccessful, 297 (44.80%) had previously stopped for over 1 year, and 138 (20.81%) had previously stopped for over 3 years.

### Beliefs Regarding AAS/PED safety

A majority ( $n = 1782$ , 74.7%) of respondents reported they believe AAS/PEDs can be used safely in the long term. This was consistent across regions and age groups. Further, 86.7% ( $n = 2073$ ) of respondents reported they would cease AAS use if they suffered a serious health problem because of AAS use; this was consistent across analyzed sub-cohorts.





**Figure 2.** Rated knowledge of AAS use of various groups. AAS = anabolic androgenic steroid.

### Attitudes and Experiences With Medical Professionals

Physicians were rated the lowest ( $4.08 \pm 2.23$ ) regarding knowledge and expertise of AAS use. Coaches/gurus ( $6.52 \pm 2.38$ ), bodybuilding websites ( $6.44 \pm 2.03$ ), and persons currently using AAS ( $5.92 \pm 2.31$ ) received the most favorable ratings (Figure 2). Most respondents ( $n = 1338$ , 56.1%) had never revealed their AAS use to a medical professional (Figure 3). Of those not disclosing AAS use to health-care providers, frequently reported reasons for this included concern for judgment from physicians/others who access medical records ( $n = 853$ , 63.75%), lack of confidence in their physician's knowledge of AAS use ( $n = 812$ , 60.69%), and concern for legal repercussions ( $n = 611$ , 45.67%). Of the participants who had reported AAS use to their health-care provider ( $n = 1047$ , 43.90%), 55.30% ( $n = 579$ ) reported feeling discriminated against by a physician for AAS use. The most frequently ordered diagnostic tests ordered for those who disclosed AAS use were basic metabolic panels (BMP) and/or complete blood count (CBC;  $n = 944$ , 90.16%), testosterone levels ( $n = 822$ , 78.51%), liver function tests (LFTs) ( $n = 726$ , 69.34%), thyroid stimulating hormone (TSH) ( $n = 522$ , 49.86%), and gonadotropins ( $n = 469$ , 44.79%; Table 3). Compared to those under age 35, those over age 35 were more likely to undergo prostate specific antigen (PSA) testing (52.7% vs. 19.6%), coronary artery calcium scan (11.1% vs. 4.9%), transthoracic echocardiogram (18.5% vs. 8.8%), and electrocardiogram (36.2% vs. 21.0%).

### Patterns of AAS/PED Use

The most frequently reported age range for starting AAS was 22–30 years ( $n = 1001$ , 41.97%), followed by 19–21 years ( $n = 691$ , 28.97%); 7.42% ( $n = 177$ ) reported

beginning AAS prior to age 18. The most frequently utilized androgens were testosterone enanthate ( $n = 1922$ , 80.62%), testosterone cypionate ( $n = 1217$ , 51.05%), metandione ( $n = 1213$ , 50.88%), trenbolone ( $n = 1199$ , 50.29%), oxandrolone ( $n = 1110$ , 46.56%), and nandrolone decanoate ( $n = 1107$ , 46.43%). The most common base dose of weekly testosterone was 500–1000 mg ( $n = 1132$ , 47.46%). The most common number of AAS compounds utilized per cycle was two ( $n = 1126$ , 47.21%) or three ( $n = 727$ , 30.48%). Continuous AAS use without PCT was reported at 47.32% ( $n = 1128$ ), while an “on-and-off” cycle approach with PCT was reported by 45.93% ( $n = 1095$ ). Please see Table 4 for details.

### Accessory Compounds/PED Use

While on an AAS cycle, commonly used accessory compounds were anastrozole ( $n = 1135$ , 47.61%), tamoxifen ( $n = 742$ , 31.12%), exemestane ( $n = 719$ , 30.16%), and hCG ( $n = 682$ , 28.61%). While off AAS, tamoxifen ( $n = 959$ , 40.23%), clomiphene citrate ( $n = 754$ , 31.63%), and hCG ( $n = 610$ , 25.59%) were most commonly used, and 32.84% ( $n = 783$ ) reported using no additional compounds when off AAS (Table 5).

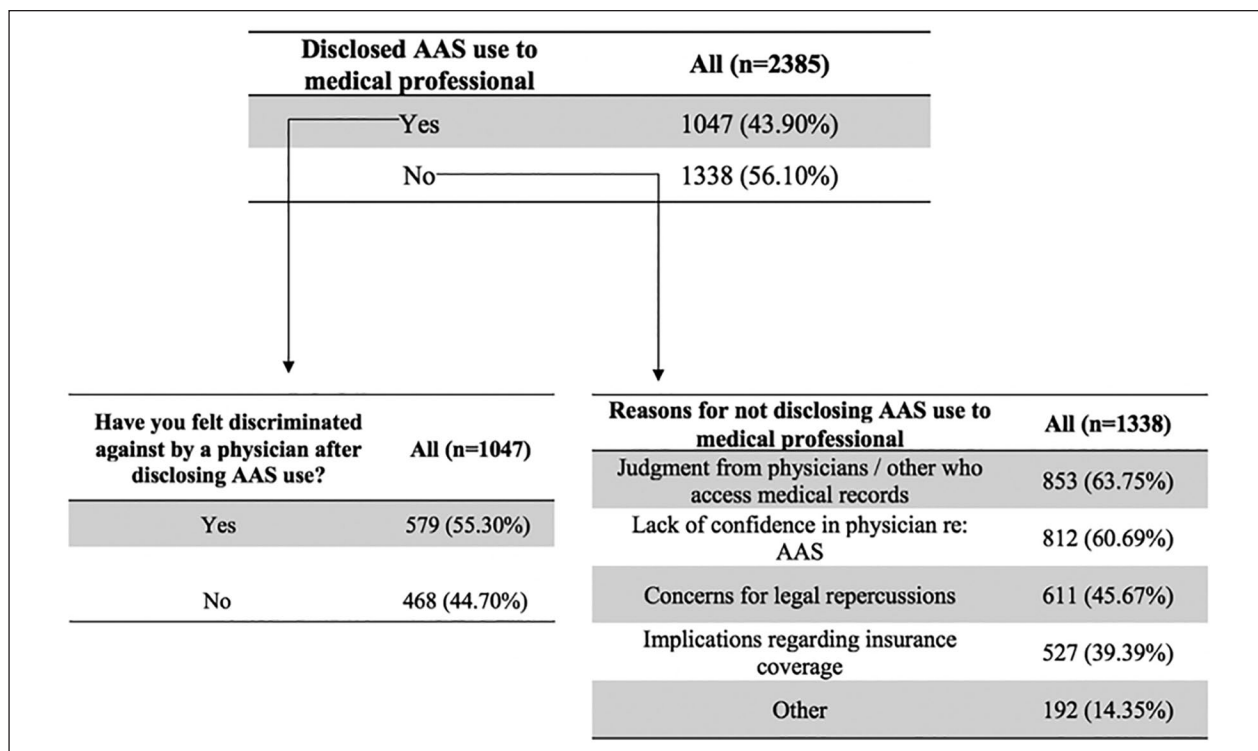
Of those reporting an “on/off cycle w/ PCT” approach to using AAS ( $n = 1095$ ), 52.51% ( $n = 575$ ) reported using both tamoxifen and clomiphene simultaneously while off AAS, while 25.02% ( $n = 274$ ) reported using tamoxifen, clomiphene, and hCG simultaneously between cycles.

### Additional Illicit Substance Use

While 42.49% ( $n = 1013$ ) reported no such use, additional illicit substance use was reported by the majority who ranked marijuana ( $n = 973$ , 40.81%), excess alcohol ( $n = 697$ , 29.24%), and cocaine ( $n = 380$ , 15.94%) as the most commonly used. Men over age 35 were less likely to use illicit substances (56.9%) compared to men under 35 (36.4%). In the under 35 group, use of marijuana (47.2% vs. 25.7%), alcohol (33.2% vs. 19.9%), cocaine (19.2% vs. 8.3%), MDMA (14.6% vs. 4.5%), psychedelics (13.9% vs. 4.2%), and nonprescription amphetamines (12.3% vs. 4.2%) was significantly more common (Table 6).

### Reported Side Effects of AAS Use

As shown in Table 7, testicular atrophy ( $n = 1501$ , 62.94%), acne ( $n = 1320$ , 55.35%), hypersexuality ( $n = 1209$ , 50.69%), hypertension ( $n = 1036$ , 43.44%), mood changes ( $n = 1017$ , 42.64%), erectile dysfunction ( $n = 786$ , 32.96%), dyslipidemia ( $n = 667$ , 27.97%), and gynecomastia ( $n = 622$ , 26.08%) were most commonly reported.



**Figure 3.** Reporting of AAS use to medical professionals. AAS = anabolic androgenic steroid.

**Table 3.** Diagnostic Workup for Men Disclosing AAS Use to Medical Providers.

Diagnostic Test	All, n = 1047 (%)	Under 35, n = 658 (%)	Over 35, n = 389 (%)	p Value <sup>a</sup>
Basic blood work (CBC, BMP)	944 (90.16)	588 (89.4)	356 (91.5)	.284
Testosterone levels	822 (78.51)	497 (75.5)	325 (83.5)	.0024
Liver function tests	726 (69.34)	423 (64.3)	303 (77.9)	.0001
Lipid profile	679 (64.85)	401 (60.9)	278 (71.5)	.0006
TSH	522 (49.86)	308 (46.8)	214 (55.0)	.0106
LH/FSH	469 (44.79)	286 (43.5)	183 (47.0)	.2745
Hemoglobin A1c	431 (41.17)	225 (34.2)	206 (53.0)	.0001
Urinalysis	351 (33.52)	184 (28.0)	167 (42.9)	.0001
PSA	334 (31.90)	129 (19.6)	205 (52.7)	.0001
Iron profile	280 (26.74)	140 (21.3)	140 (36.0)	.0001
ECG	279 (26.65)	138 (21.0)	141 (36.2)	.0001
Additional tests not listed	192 (18.34)	116 (17.6)	76 (19.5)	.4575
TTE	130 (12.42)	58 (8.8)	72 (18.5)	.0001
Coronary artery calcium scoring	75 (7.16)	32 (4.9)	43 (11.1)	.0003
Bone densitometry (DEXA)	66 (6.30)	33 (5.0)	33 (8.5)	.0345

Note. <sup>a</sup>over 35 vs under 35. AAS = anabolic androgenic steroid, CBC = complete blood count, BMP = basic metabolic panel, TSH = thyroid stimulating hormone, LH = luteinizing hormone, FSH = follicle stimulating hormone, PSA = prostate specific antigen, ECG = electrocardiogram, TTE = transthoracic echocardiogram.

Dyslipidemia (32.91% vs. 25.88%), hair loss (27.12% vs. 20.69%), tendon rupture (9.89% vs. 6.92%), left ventricular hypertrophy (6.64% vs. 2.92%), infertility (9.82% vs. 6.92%), injection site abscess (12.43% vs. 8.05%), and polycythemia (20.9% vs. 9.0%) were significantly more common in respondents over 35 years old.

## Discussion

To our knowledge, this is the largest published quantitative survey of AAS use to date in the medical literature. Cohen et al. (2007) published a survey of 1955 men using AAS in the United States in 2007, while other studies

**Table 4.** Patterns of AAS/PED Use.

AAS Compound	All, <i>n</i> = 2384 (%)	AAS Compound	All, <i>n</i> = 2384 (%)
Testosterone enanthate (Test E)	1922 (80.62)	Drostanolol (Masteron)	771 (32.43)
Testosterone cypionate (Test C)	1217 (51.05)	Oxymetholone (Anadrol)	746 (31.29)
Metandione (Dianabol)	1213 (50.88)	Mesterolone (Proviron)	624 (26.17)
Trenbolone (Tren, Fina)	1199 (50.29)	Compound not listed	544 (22.82)
Oxandrolone (Anavar)	1110 (46.56)	Nandrolone phenylpropionate (NPP)	478 (20.05)
Nandrolone Decanoate (Deca)	1107 (46.43)	Turinabol (CDMT)	449 (18.83)
Boldenone (Equipose / Test EQ)	939 (39.39)	Methasterone (Superdrol)	369 (15.48)
Testosterone propionate	925 (38.80)	Metenolone (Primobolan)	368 (15.44)
Stanozolol (Winstrol, Winny)	909 (38.13)	Methyl-1-testosterone (Methyl-1)	137 (5.75)
Sustanon 250 (Mixture of testosterone esters)	859 (36.03)	None of the above	9 (0.38)

Age of Starting AAS Use	All, <i>n</i> = 2385 (%)	Number of AAS/Prohormones During a Typical Cycle	All, <i>n</i> = 2385 (%)
22–30 years	1001 (41.97)	1	384 (16.10)
19–21 years	691 (28.97)	2	1126 (47.21)
31–40 years	341 (14.30)	3	727 (30.48)
Less than 18 years	177 (7.42)	4	118 (4.95)
41 years+	175 (7.34)	5 or more	30 (1.26)

Duration of AAS Use	All, <i>n</i> = 2385 (%)	Dose of Base Testosterone Per Week	All, <i>n</i> = 2385 (%)
Less than 2 weeks	14 (0.59)	501–1000 mg	1132 (47.46)
2 weeks–2 months	195 (8.18)	Less than 500 mg	1097 (46.00)
2–6 months	411 (17.23)	1001–2000 mg	131 (5.49)
6–12 months	296 (12.41)	2001–3000 mg	18 (0.75)
1–2 years	385 (16.14)	3001–4000 mg	4 (0.17)
2–3 years	281 (11.78)	Over 5001 mg	2 (0.08)
3–4 years	242 (10.15)	4001–5000 mg	1 (0.04)
Over 4 years	561 (23.52)		

Pattern of AAS Use	All, <i>n</i> = 2385 (%)
Continued AAS use, no PCT (Blast and cruise)	1128 (47.32%)
On and off cycle with PCT	1095 (45.93%)
On and off cycle with no PCT	296 (12.42%)
Other	130 (5.45%)

Note. AAS = anabolic androgenic steroid, PED = performance enhancing drug, PCT = post-cycle therapy.

such as Parkinson and Evans (2006) and Rowe et al. (2017) surveyed 496 and 605 men using AAS, respectively. The profile of males using AAS that emerged from our data resembled that presented in earlier studies, suggesting reliability of our data. Our findings expanded on this populations' experiences with health care and attempted cessation.

We noted that AAS use often begins at a young age with markedly supraphysiologic testosterone doses of 500–1000 mg per week, which is five to 10 times of that used for treatment of male hypogonadism. Even more concerning is that 7.42% of men reported AAS use prior to age 18, indicating a significant need for improved AAS education and awareness directed toward adolescents.

The prevalence of body image disorders serving as a motivation to use AAS in our data (29.5%) supports the multidisciplinary challenges noted in prior studies (de Ronde & Smit, 2020; Goldman et al., 2019; Pope et al., 2017). The combination of easily accessed AAS compounds via the internet, early onset of use with high-dose androgens, and prevalence of body image disorders has created a greater need than ever for medical resources for these patients.

Testosterone esters, nandrolone compounds, and oral alkylated AAS were the most used androgens, consistent with prior surveys and reported steroid cycles (Cohen et al., 2007; Steroids: What Pro Bodybuilders Are Really Using, 2015). Utilization of accessory PED compounds

**Table 5.** Accessory PED Use.

On-Cycle Compound	All, <i>n</i> = 2384 (%)	Off-Cycle Compound	All, <i>n</i> = 2384 (%)
Anastrozole (Arimidex)	1135 (47.61)	Tamoxifen (Nolvadex)	959 (40.23)
Tamoxifen (Nolvadex)	742 (31.12)	None	783 (32.84)
Exemestane (Aromasin)	719 (30.16)	Clomiphene (Clomid)	754 (31.63)
Human chorionic gonadotropin (hCG)	682 (28.61)	Human chorionic gonadotropin	610 (25.59)
Clenbuterol	439 (18.41)	Anastrozole (Arimidex)	387 (16.23)
SARMs	385 (16.15)	Exemestane (Aromasin)	216 (9.06)
Clomiphene (Clomid)	352 (14.77)	SARMs	191 (8.01)
Human growth hormone (hGH)	327 (13.72)	Human growth hormone (hGH)	155 (6.50)
Ephedrine/Ephedra	307 (12.88)	Other agents	126 (5.29)
None	292 (12.25)	Clenbuterol	125 (5.24)
Cabergoline (Dostinex) / Bromocriptine (Parlodel)	266 (11.16)	Ephedrine/Ephedra	108 (4.53)
Letrozole (Femara)	200 (8.39)	Other peptides not listed	106 (4.45)
Other peptides not listed	196 (8.22)	Letrozole (Femara)	68 (2.85)
Liothyronine (T3, Cytomel)	196 (8.22)	Cabergoline (Dostinex) / Bromocriptine (Parlodel)	38 (1.59)
Other agents	179 (7.51)	Liothyronine (T3, Cytomel)	36 (1.51)
Insulin	132 (5.54)	Insulin-like growth factor (IGF-1)	34 (1.43)
Diuretics	95 (3.98)	Dinitrophenol (DNP)	33 (1.38)
Insulin-like growth factor (IGF-1)	93 (3.90)	Insulin	29 (1.22)
Dinitrophenol (DNP)	93 (3.90)	CJC 1295 DAC	27 (1.13)
Levothyroxine (T4, Synthroid)	68 (2.85)	MOD-GRF 1-29	21 (0.88)
CJC 1295 DAC	56 (2.35)	Levothyroxine (T4, Synthroid)	16 (0.67)
MOD-GRF 1-29	39 (1.64)	Diuretics	15 (0.63)
Sermorelin	38 (1.59)	Sermorelin	14 (0.59)

Note. PED = performance enhancing drug.

**Table 6.** Additional Illicit Substance Use.

Other Illicit Drug Use in the Past Year	All, <i>n</i> = 2384 (%)	Under 35, <i>n</i> = 1676 (%)	Over 35, <i>n</i> = 708 (%)	<i>p</i> Value <sup>a</sup>
None of the above	1013 (42.49)	610 (36.4)	403 (56.9)	<.0001
Marijuana	973 (40.81)	791 (47.2)	182 (25.7)	<.0001
Alcohol (More than four drinks per day, or 14 drinks per week)	697 (29.24)	556 (33.2)	141 (19.9)	<.0001
Cocaine	380 (15.94)	321 (19.2)	59 (8.3)	<.0001
MDMA/Ecstasy	276 (11.58)	244 (14.6)	32 (4.5)	<.0001
Psychedelics	263 (11)	233 (13.9)	30 (4.2)	<.0001
Nonprescribed amphetamines	236 (9.90)	206 (12.3)	30 (4.2)	<.0001
Nonprescription opioids (excluding heroin)	124 (5.20)	92 (5.5)	32 (4.5)	.3644
Heroin	20 (0.84)	12 (0.7)	8 (1.1)	.3292

Note. <sup>a</sup>Under 35 versus Over 35.

varied significantly, as expected, with whether respondents were “on” or “off” cycle. Over half of the men utilizing an “on-and-off-cycle” approach with PCT reported using both tamoxifen and clomiphene simultaneously, consistent with a popular regimen propagated on forums and underground steroid guides (Llewellyn, 2017). Discussing individual experiences with these compounds may provide valuable information for the clinician when

determining an optimal strategy to treat AAS withdrawal symptoms associated with attempted cessation. For example, a man who reports prior success cycling off AAS by utilizing SERMs may be willing to try medically supervised treatment with such compounds.

Over 94% of respondents reported side effects from their use, stressing the importance of providing medical care for this population. Congruent with prior studies



**Table 7.** Reported Side Effects of AAS Use.

What Side Effects Have you Experienced From AAS Use?	All Participants, <i>n</i> = 2385 (%)	Under 35, <i>n</i> = 1677 (%)	Over 35, <i>n</i> = 708 (%)	<i>p</i> Value <sup>a</sup>
Testicular atrophy	1501 (62.94)	1042 (62.13)	459 (64.83)	.2277
Acne	1320 (55.35)	1022 (60.94)	298 (42.09)	<.0001
Hypersexuality	1209 (50.69)	863 (51.46)	346 (48.87)	.2625
Hypertension	1036 (43.44)	733 (43.71)	303 (42.80)	.6844
Mood changes	1017 (42.64)	738 (44.01)	279 (39.41)	.0414
Erectile dysfunction	786 (32.96)	539 (32.14)	247 (34.89)	.1982
Dyslipidemia	667 (27.97)	434 (25.88)	233 (32.91)	.0006
Gynecomastia	622 (26.08)	456 (27.19)	166 (23.45)	.0590
Hair loss/MPB	539 (22.60)	347 (20.69)	192 (27.12)	.0007
Polycythemia	299 (12.54)	151 (9.00)	148 (20.90)	<.0001
Injection site abscess	223 (9.35)	135 (8.05)	88 (12.43)	.0012
Infertility	186 (7.80)	116 (6.92)	70 (9.89)	.0153
No side effects	140 (5.87)	97 (5.78)	43 (6.07)	.7755
Other	126 (5.28)	93 (5.55)	33 (4.66)	.4233
Tendon rupture	123 (5.16)	53 (3.16)	70 (9.89)	<.0001
LVH	96 (4.03)	49 (2.92)	47 (6.64)	<.0001
CKD	28 (1.17)	13 (0.78)	15 (2.12)	.0107
CHF	18 (0.75)	11 (0.66)	7 (0.99)	.4384
MI	17 (0.71)	10 (0.60)	7 (0.99)	.2960
DVT/PE	13 (0.55)	7 (0.42)	6 (0.85)	.2245
CAD	10 (0.42)	7 (0.42)	3 (0.42)	1.0000
Stroke	10 (0.42)	7 (0.42)	3 (0.42)	1.0000

Note. <sup>a</sup>Under 35 versus Over 35. AAS = anabolic androgenic steroid, MPB = male pattern baldness, LVH = left ventricular hypertrophy, CKD = chronic kidney disease, CHF = congestive heart failure, MI = myocardial infarction, DVT = deep vein thrombosis, PE = pulmonary embolism, CAD = coronary artery disease.

(Dennington et al., 2008; Grogan et al., 2006; Maycock & Howat, 2005; Pope et al., 2004), this population generally found medical professionals unknowledgeable regarding AAS and indicated fear of judgment or repercussions as a barrier to disclosing their use. These concerns are valid, as most men in our study who disclosed AAS use to their physician reported feeling discriminated against after doing so. Furthermore, the reported diagnostic workup of men disclosing AAS use to their health-care providers appeared inconsistent and at times inadequate. Coronary artery calcium (CAC) scoring was performed in only 11.1% of men over 35, and 4.9% in men under 35. Yet, a prior study of bodybuilders using AAS reported that 50% had CAC scores much higher than expected for their age (Santora et al., 2006). In our study, transthoracic echocardiograms were performed in 18.5% men over 35 and in 8.8% of younger patients. Given the increased frequency of left ventricular hypertrophy (LVH), hypertension, and atherosclerosis seen with AAS use (Alizade et al., 2016; Baggish et al., 2017; Thiblin et al., 2015), our data suggest that TTEs are likely underutilized in this population. The lack of additional indicated testing for this population supported a prior study, concluding that physicians do not have adequate knowledge of AAS (Hill & Waring, 2019).

Many patients reporting physicians as an AAS source also reported obtaining additional illicit AAS compounds in addition to prescribed therapy. In a cohort of over 6000 men with hypogonadism, it was identified that 20.9% had a history of prior AAS use (Coward et al., 2013). This potential underscore the need for clinicians to have an open and nonjudgmental discussion with patients before prescribing testosterone therapy, especially if recent or concurrent AAS use is suspected. “Physician source” may also include prescriptions from “men’s health centers” and “integrative” or “anti-aging” centers, which commonly prescribe compounds such as anabolic steroids, growth hormone, and porcine thyroid hormone in an inappropriate manner (Irwig et al., 2020).

While most respondents reported they felt AAS could be safely taken in the long term, a greater majority reported they would stop AAS use if they experienced a serious health problem. This suggests many men using AAS care about their health, but do not believe the risk of serious side effects is significant enough to consider cessation. Implementing public education regarding AAS use and ensuring easier access to appropriate health care for this population could help improve upon this.

Most men using AAS reported difficulty with prolonged cessation. While half of respondents attempted

to quit, over 60% returned to using AAS. Recidivism was common even after prolonged cessation, as 44.8% of those who had ceased AAS use for over a year and 20.8% of those not using for over 3 years returned to AAS use. This reflects previous reports that nonmedically addressed AAS withdrawal symptoms present challenges to attempted cessation (Kanayama, Hudson, et al., 2015; O'Connor & Hoekstra, 2018; Rahnama et al., 2014).

The disconnect that exists between patients struggling with cessation and medical professionals inadequately prepared to care for these men continues to broaden as AAS use becomes more prevalent. Urgent efforts on behalf of the medical community are needed. Initiatives directed toward assisting patients with cessation and offering access to high yield screen tests (such as lipid profile, BMP, CBC, and cardiac screening) for harm minimization should take priority. Additional research regarding the management of AAS withdrawal symptoms will be paramount in decreasing high rates of unsuccessful cessation.

## Conclusions

Our updated data on attitudes and behavior of men using AAS should serve to reinforce previous calls to action for further research on the treatment of AAS use disorder. Particularly concerning are the young age at which use begins, the extreme supraphysiologic doses utilized, distrust of the health-care professionals, and lack of harm-minimization strategies. Poor rates of sustained AAS cessation are accompanied by the absence of medical resources to assist patients in need. Randomized control trials examining pharmacologic and behavioral approaches to AAS withdrawal and HPT axis recovery would be of immense clinical benefit. Our findings suggest the broad distrust of health-care providers will make recruitment for such studies increasingly difficult. Therefore, as a first step, medical education should emphasize the importance of an informed, nonjudgmental, and harm-mitigation approach to these patients. A multidisciplinary approach that includes medical professionals, addiction support groups, and behavioral health specialists is essential to support successful harm reduction and cessation of AAS use.

## Limitations

The many uncensored online AAS forums have been an underutilized setting for research (Brennan et al., 2017). However, our study may have a sampling bias, in that men using AAS who do not frequently visit these forums and YouTube channel, or those without internet access, would have been unable to participate. While responses

were anonymous, the illegal nature of AAS may have discouraged some respondents from answering truthfully. Due to the demographics of our participants, results are most applicable to Caucasian men between 18 and 30 years in the United States. The exclusion of men who had not used in the past 5 years limits the ability to assess long-term cessation rates.

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The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Alex K Bonnecaze and Joseph A Aloï have no disclosures or COI to disclose. Thomas O' Connor owns and operates an internal medicine private practice based out of Essex, CT, and has written a book on the health consequences of androgen misuse.

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## ORCID iD

Alex K. Bonnecaze  <https://orcid.org/0000-0002-9642-7222>

## References

- Achar, S., Rostamian, A., & Narayan, S. M. (2010). Cardiac and metabolic effects of anabolic-androgenic steroid abuse on lipids, blood pressure, left ventricular dimensions, and rhythm. *The American Journal of Cardiology*, *106*(6), 893–901. <https://doi.org/10.1016/j.amjcard.2010.05.013>
- Alizade, E., Avci, A., Tabakci, M. M., Toprak, C., Zehir, R., Acar, G., Kargin, R., Emiroglu, M. Y., Akçakoyun, M., & Pala, S. (2016). Comparison of right ventricle systolic function between long-term anabolic-androgenic steroid user and nonuser bodybuilder athletes: A study of two-dimensional speckle tracking echocardiography. *Echocardiography (Mount Kisco, N.Y.)*, *33*(8), 1178–1185. <https://doi.org/10.1111/echo.13243>
- Anawalt, B. D. (2019). Diagnosis and management of anabolic androgenic steroid use. *The Journal of Clinical Endocrinology and Metabolism*. <https://doi.org/10.1210/jc.2018-01882>
- Baggish, A. L., Weiner, R. B., Kanayama, G., Hudson, J. I., Lu, M. T., Hoffmann, U., & Pope, H. G. (2017). Cardiovascular toxicity of illicit anabolic-androgenic steroid use. *Circulation*, *135*(21), 1991–2002. <https://doi.org/10.1161/CIRCULATIONAHA.116.026945>

- Bertozzi, G., Salerno, M., Pomara, C., & Sessa, F. (2019). Neuropsychiatric and behavioral involvement in AAS abusers. A literature review. *Medicina (Kaunas, Lithuania)*, 55(7). <https://doi.org/10.3390/medicina55070396>
- Bhasin, S., Brito, J. P., Cunningham, G. R., Hayes, F. J., Hodis, H. N., Matsumoto, A. M., Snyder, P. J., Swerdloff, R. S., Wu, F. C., & Yialamas, M. A. (2018). Testosterone therapy in men with hypogonadism: An endocrine society clinical practice guideline. *The Journal of Clinical Endocrinology and Metabolism*, 103(5), 1715–1744. <https://doi.org/10.1210/jc.2018-00229>
- Brennan, R., Wells, J. S. G., & Van Hout, M. C. (2017). The injecting use of image and performance-enhancing drugs (IPED) in the general population: A systematic review. *Health & Social Care in the Community*, 25(5), 1459–1531. <https://doi.org/10.1111/hsc.12326>
- Chainy, G. B., Samantaray, S., & Samanta, L. (1997). Testosterone-induced changes in testicular antioxidant system. *Andrologia*, 29(6), 343–349. <https://doi.org/10.1111/j.1439-0272.1997.tb00328.x>
- Cohen, J., Collins, R., Darkes, J., & Gwartney, D. (2007). A league of their own: Demographics, motivations and patterns of use of 1,955 male adult non-medical anabolic steroid users in the United States. *Journal of the International Society of Sports Nutrition*, 4, 12. <https://doi.org/10.1186/1550-2783-4-12>
- Coviello, A. D., Kaplan, B., Lakshman, K. M., Chen, T., Singh, A. B., & Bhasin, S. (2008). Effects of graded doses of testosterone on erythropoiesis in healthy young and older men. *The Journal of Clinical Endocrinology and Metabolism*, 93(3), 914–919. <https://doi.org/10.1210/jc.2007-1692>
- Coward, R. M., Rajanahally, S., Kovac, J. R., Smith, R. P., Pastuszak, A. W., & Lipshultz, L. I. (2013). Anabolic steroid induced hypogonadism in young men. *The Journal of Urology*, 190(6), 2200–2205. <https://doi.org/10.1016/j.juro.2013.06.010>
- de Ronde, W., & Smit, D. L. (2020). Anabolic androgenic steroid abuse in young males. *Endocrine Connections*. <https://doi.org/10.1530/EC-19-0557>
- Dennington, V., Finney Lamb, C., Dillon, P., Larance, B., Drug and Alcohol Services South Australia, Australia, Department of Health and Ageing, Drug Strategy Branch, & National Drug and Alcohol Research Centre (Australia). (2008). *Qualitative field study for users of performance and image enhancing drugs*. Drug and Alcohol Services South Australia.
- Fink, J., Schoenfeld, B. J., Hackney, A. C., Matsumoto, M., Maekawa, T., Nakazato, K., & Horie, S. (2019). Anabolic-androgenic steroids: Procurement and administration practices of doping athletes. *The Physician and Sportsmedicine*, 47(1), 10–14. <https://doi.org/10.1080/00913847.2018.1526626>
- Goldman, A. L., Pope, H. G., & Bhasin, S. (2019). The health threat posed by the hidden epidemic of anabolic steroid use and body image disorders among young men. *The Journal of Clinical Endocrinology and Metabolism*, 104(4), 1069–1074. <https://doi.org/10.1210/jc.2018-01706>
- Grogan, S., Shepherd, S., Evans, R., Wright, S., & Hunter, G. (2006). Experiences of anabolic steroid use: In-depth interviews with men and women body builders. *Journal of Health Psychology*, 11(6), 845–856. <https://doi.org/10.1177/1359105306069080>
- Harris, P. A., Taylor, R., Minor, B. L., Elliott, V., Fernandez, M., O'Neal, L., McLeod, L., Delacqua, G., Delacqua, F., Kirby, J., & Duda, S. N. (2019). The REDCap consortium: Building an international community of software platform partners. *Journal of Biomedical Informatics*, 95, 103208. <https://doi.org/10.1016/j.jbi.2019.103208>
- Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics*, 42(2), 377–381. <https://doi.org/10.1016/j.jbi.2008.08.010>
- Hauger, L. E., Sagoe, D., Vaskinn, A., Arnevik, E. A., Leknes, S., Jørstad, M. L., & Bjørnebekk, A. (2019). Anabolic androgenic steroid dependence is associated with impaired emotion recognition. *Psychopharmacology*, 236(9), 2667–2676. <https://doi.org/10.1007/s00213-019-05239-7>
- Hill, S. A., & Waring, W. S. (2019). Pharmacological effects and safety monitoring of anabolic androgenic steroid use: Differing perceptions between users and health-care professionals. *Therapeutic Advances in Drug Safety*, 10, 2042098619855291. <https://doi.org/10.1177/2042098619855291>
- Irwig, M. S., Fleseriu, M., Jonklaas, J., Tritos, N. A., Yuen, K. C. J., Correa, R., Elhomay, G., Garla, V., Jasim, S., Soe, K., Baldeweg, S. E., Boguszewski, C. L., & Bancos, I. (2020). Off-label use and misuse of testosterone, growth hormone, thyroid hormone, and adrenal supplements: Risks and costs of a growing problem. *Endocrine Practice: Official Journal of the American College of Endocrinology and the American Association of Clinical Endocrinologists*, 26(3), 340–353. <https://doi.org/10.4158/PS-2019-0540>
- Kanayama, G., DeLuca, J., Meehan, W. P., Hudson, J. I., Isaacs, S., Baggish, A., Weiner, R., Micheli, L., & Pope, H. G. (2015). Ruptured tendons in anabolic-androgenic steroid users: A Cross-Sectional Cohort Study. *The American Journal of Sports Medicine*, 43(11), 2638–2644. <https://doi.org/10.1177/0363546515602010>
- Kanayama, G., Hudson, J. I., DeLuca, J., Isaacs, S., Baggish, A., Weiner, R., Bhasin, S., & Pope, H. G. (2015). Prolonged hypogonadism in males following withdrawal from anabolic-androgenic steroids: An under-recognized problem. *Addiction (Abingdon, England)*, 110(5), 823–831. <https://doi.org/10.1111/add.12850>
- Kicman, A. T. (2008). Pharmacology of anabolic steroids. *British Journal of Pharmacology*, 154(3), 502–521. <https://doi.org/10.1038/bjp.2008.165>
- Llewellyn, W. (2017). *ANABOLICS*. Molecular Nutrition.
- Maycock, B., & Howat, P. (2005). The barriers to illegal anabolic steroid use. *Drugs: Education, Prevention and Policy*, 12(4), 317–325. <https://doi.org/10.1080/09687630500103622>
- Niedfeldt, M. W. (2018). Anabolic steroid effect on the liver. *Current Sports Medicine Reports*, 17(3), 97–102. <https://doi.org/10.1249/JSR.0000000000000467>
- O'Connor, T., & Hoekstra, K. (2018). *America on steroids: A time to heal*. Metabolic Promotion LLC.

- Parkinson, A. B., & Evans, N. A. (2006). Anabolic androgenic steroids: A survey of 500 users. *Medicine and Science in Sports and Exercise*, 38(4), 644–651. <https://doi.org/10.1249/01.mss.0000210194.56834.5d>
- Pope, H. G., Kanayama, G., Ionescu-Pioggia, M., & Hudson, J. I. (2004). Anabolic steroid users' attitudes towards physicians. *Addiction (Abingdon, England)*, 99(9), 1189–1194. <https://doi.org/10.1111/j.1360-0443.2004.00781.x>
- Pope, H. G., Khalsa, J. H., & Bhasin, S. (2017). Body image disorders and abuse of anabolic-androgenic steroids among men. *JAMA*, 317(1), 23–24. <https://doi.org/10.1001/jama.2016.17441>
- Pope, H. G., Wood, R. I., Rogol, A., Nyberg, F., Bowers, L., & Bhasin, S. (2014). Adverse health consequences of performance-enhancing drugs: An Endocrine Society scientific statement. *Endocrine Reviews*, 35(3), 341–375. <https://doi.org/10.1210/er.2013-1058>
- Rahnema, C. D., Lipshultz, L. I., Crosnoe, L. E., Kovac, J. R., & Kim, E. D. (2014). Anabolic steroid-induced hypogonadism: Diagnosis and treatment. *Fertility and Sterility*, 101(5), 1271–1279. <https://doi.org/10.1016/j.fertnstert.2014.02.002>
- Rasmussen, J. J., Selmer, C., Østergren, P. B., Pedersen, K. B., Schou, M., Gustafsson, F., Faber, J., Juul, A., & Kistorp, C. (2016). Former abusers of anabolic androgenic steroids exhibit decreased testosterone levels and hypogonadal symptoms years after cessation: A case-control study. *PLoS One*, 11(8), e0161208. <https://doi.org/10.1371/journal.pone.0161208>
- Rowe, R., Berger, I., & Copeland, J. (2017). “No pain, no gainz”? Performance and image-enhancing drugs, health effects and information seeking. *Drugs: Education, Prevention and Policy*, 24(5), 400–408. <https://doi.org/10.1080/09687637.2016.1207752>
- Santora, L. J., Marin, J., Vangrow, J., Minegar, C., Robinson, M., Mora, J., & Friede, G. (2006). Coronary calcification in body builders using anabolic steroids. *Preventive Cardiology*, 9(4), 198–201. <https://doi.org/10.1111/j.1559-4564.2006.05210.x>
- Smit, D. L., de Hon, O., Venhuis, B. J., den Heijer, M., & de Ronde, W. (2020). Baseline characteristics of the HAARLEM study: 100 male amateur athletes using anabolic androgenic steroids. *Scandinavian Journal of Medicine & Science in Sports*, 30(3), 531–539. <https://doi.org/10.1111/sms.13592>
- Smit, D. L., & de Ronde, W. (2018). Outpatient clinic for users of anabolic androgenic steroids: An overview. *The Netherlands Journal of Medicine*, 76(4), 167.
- Steroids: What Pro Bodybuilders Are Really Using*. (2015, January 8). <https://www.t-nation.com/pharma/steroids-what-pro-bodybuilders-are-really-using>
- Tatem, A. J., Beilan, J., Kovac, J. R., & Lipshultz, L. I. (2019). Management of anabolic steroid-induced infertility: Novel strategies for fertility maintenance and recovery. *The World Journal of Men's Health*. <https://doi.org/10.5534/wjmh.190002>
- Thiblin, I., Garmo, H., Garle, M., Holmberg, L., Byberg, L., Michaëlsson, K., & Gedeberg, R. (2015). Anabolic steroids and cardiovascular risk: A national population-based cohort study. *Drug and Alcohol Dependence*, 152, 87–92. <https://doi.org/10.1016/j.drugalcdep.2015.04.013>
- Thiblin, I., Runeson, B., & Rajs, J. (1999). Anabolic androgenic steroids and suicide. *Annals of Clinical Psychiatry: Official Journal of the American Academy of Clinical Psychiatrists*, 11(4), 223–231.
- Zahnow, R., McVeigh, J., Ferris, J., & Winstock, A. (2017). Adverse effects, health service engagement, and service satisfaction among anabolic androgenic steroid users. *Contemporary Drug Problems*, 44(1), 69–83. <https://doi.org/10.1177/0091450917694268>