

## ORIGINAL ARTICLE

# Prevalence, mental health and substance use of anabolic steroid users: a population-based study on young individuals

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## Abstract

**Aims:** The use of anabolic androgen steroids to enhance performance is not a modern phenomenon. However, the majority of today's anabolic androgen steroid users are not competitive athletes, but individuals who want to look leaner and muscular. This study aimed to examine the prevalence of anabolic androgen steroid use among young individuals and assess whether their mental health, lifestyle and substance use differ from non-anabolic androgen steroid users. **Methods:** A population-based study conducted in secondary schools, mean age was 17.3 years. A total of 10,259 participants (50% young women, 1% reported gender as 'other', 49% young men) answered questions on mental health, anabolic androgen steroid use, substance use and sports participation. Statistical analysis included descriptive statistics, *t*-test,  $\chi^2$  and logistic regression. **Results:** The prevalence of anabolic androgen steroid use was 1.6%, and 78% of users were young men. Anabolic androgen steroid users had more anger issues, anxiety, depression, and their self-esteem was lower than among non-anabolic androgen steroid users ( $P < 0.05$ ). A larger proportion of anabolic androgen steroid users, 30%, had attempted suicide compared to 10% of non-users ( $\chi^2 (1, 9580) = 57.5, P < 0.001$ ). Proportionally, anabolic androgen steroid users were more likely to take medicine for mental health problems and misuse substances than non-users. Participation in non-organised sports, increased anger and body image were associated with increased odds of using anabolic androgen steroids. **Conclusions:** Anabolic androgen steroid use is a public health threat. It had an alarming effect on the life of individuals who report having used anabolic androgen steroids. Authorities, healthcare workers, parents and others working with young people need to be informed of the signs and risks of anabolic androgen steroid use to reduce future negative implications.

**Keywords:** Mental health, anabolic androgen steroids, young individuals, substance use, performance-enhancing drugs

## Introduction

The use of performance-enhancing drugs is not a modern reality. It goes as far back as ancient times when Greek Olympic athletes and Roman gladiators used herbs, mushrooms and plants to boost their performance [1]. The first known case of anabolic androgenic steroids (AAS) use to enhance performance is from a weightlifting championship in 1954 [1]. AAS contain synthetic testosterone, the male hormone, which produces the male characteristics

(androgenic effect) and endorses the growth of skeletal muscle (anabolic effects) [1]. The power of AAS was, for many years, a well-kept secret among elite athletes, their coaches and medical staff. It was not until the late 1980s that AAS use among the general population was confirmed when high school boys in the USA reported the use of them in a survey. The interesting results were that they did not only use the AAS to increase their performance in sports but also to improve their appearance [2]. The use of AAS has

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grown terribly among the general population, and most users today are individuals who want to look muscular and leaner [3].

Due to the widespread AAS use and the serious side effects that follow, there has been speculation about whether the use has become a public health crisis [1,3]. The particular health concern is the use of adolescents that misuse AAS during a vulnerable period in their biological and psychological growth [4]. The known physical side effects of AAS use have been found to include anatomical changes in the brain, hair loss, liver tumours, acne, sweating, injection site abscess and cardiovascular disease [5]. Among men, the effects of AAS use are a reduction in testicle size, low sperm count, infertility, balding, prostatism and breast development, which requires cosmetic surgery [4]. Among women, the symptoms of AAS use are facial hair growth, deepening of voice, baldness, enlarged clitoris, menstrual dysfunction, infertility and malformation of a fetus if one becomes pregnant while using AAS [6].

#### *Prevalence of AAS use*

Studies on the worldwide prevalence of AAS use are scarce [7]. The majority of the studies on AAS use are case reports and small cohort studies on the adverse effects of AAS [8]. It has been estimated that the prevalence of adolescents' AAS use worldwide is 2.3% [7]. A meta-analysis of Nordic studies on young individuals, estimated the rates of AAS use to be 0.3–2.1%. For Iceland, the prevalence was 0.7% [9], and like other studies have found [1], the prevalence of AAS use was higher for men than women [9].

#### *Mental health and substance use among AAS users*

The most common psychological effects of AAS use are mood related. The use of AAS is most often periodically with breaks between to rebuild one's testosterone production [6]. Hypomania, manic or psychotic symptoms correlate with AAS use. Anxiety, major depression, fatigue, impaired concentration, sleeping problems, impotence and suicidality correlate with AAS discontinuation, resulting in about 30% of users developing an AAS dependence [1]. Aggression is problematic among AAS users, especially when combined with psychoactive substances [10]. The use of cannabis, cocaine, or other substances to reduce the side effects of AAS use is well known [1,4]. In a qualitative study, men described psychological strain as they had compromised their morals and felt guilt during the entire time they used AAS [11]. Participants also described manic-like

features, praising hyperactivity, increased sexual appetite, grandiose beliefs and euphoria [11]. Participants agreed that there is a strong psychological dependence on AAS due to the positive comments they get on their appearance [11]. The use of AAS is associated with muscle dysmorphia in both genders [12,13]. Use among young men is believed to be due to augmented emphasis in western societies on low body fat and toned muscles [14]. This preoccupation with muscularity may have led to an increase in eating disorders among young men [13], disturbed body image [6,13] and a physical stature that is far beyond what can be expected by natural means [14]. Among women, AAS use is associated with an increased risk of having experienced abuse, either physical or sexual [6]. Women report using weightlifting and AAS as a defence strategy after being sexually assaulted [12]. A recent Norwegian study [5] on users who sought help to quit using AAS revealed that mental health problems were the most common motivation to quit. Both genders reported depression, anxiety and a change in behaviour, and those who used other illicit substances had a greater number of mental health problems than those who were not polysubstance abusers [5].

Self-harm and suicide attempts are also known effects of AAS use, especially during the withdrawal stage [15]. Eight medicolegally cases of suicide in 21–33-year-old men using AAS revealed five suicides committed during AAS use and two suicides during withdrawal of AAS [15]. Lindqvist et al. [16] indicated that studies on former elite athletes in power sports revealed that suicide was increased two to four times, and the mortality rate was 4.6 times higher compared to non-users.

#### **Aims**

Most studies conducted until now on AAS use and its association with various health outcomes have been case studies or small cohort studies. Therefore, information on the prevalence of AAS use in the general public is scarce as well as the comparison with non-AAS users' health. This population-based study aimed to analyse the prevalence of AAS use among young individuals and assess whether their mental health, lifestyle and substance use differ from non-AAS users.

#### **Methods**

##### *Data and study sample*

Data were collected in October 2018 by the Icelandic Centre for Social Research and Analysis. A detailed

Table I. Number (%) of participants by age and gender.

Participants' age	Male (%)	Female (%)	Other <sup>1</sup> (%)	Did not report gender (%)	Total (%)
20 Years and older	462 (59.8)	289 (37.3)	15 (1.9)	8 (1.0)	774 (7.5)
19 Years	524 (52.0)	474 (47.0)	8 (0.8)	3 (0.2)	1009 (9.8)
18 Years	1057 (45.8)	1229 (53.2)	15 (0.7)	5 (0.3)	2306 (22.5)
17 Years	1250 (47.4)	1363 (51.8)	14 (0.5)	8 (0.3)	2635 (25.7)
16 Years and younger	1457 (47.4)	1577 (51.3)	31 (1.0)	8 (0.3)	3073 (30.0)
Did not report age	199 (43.1)	169 (36.6)	6 (1.3)	88 (19.0)	462 (4.5)
Total	4949 (48.2)	5101 (49.7)	89 (0.9)	120 (1.2)	10259

<sup>1</sup>Those who define their gender not as male or female.

description of the protocol for data collection has been published previously [17]. The Icelandic Data Protection Authority approved the research project in accordance with the Icelandic Act on Processing of Personal Data.

This population-based study included all students present in school on the day the study was conducted. A total of 10,259 participants answered a questionnaire, which is 79% of all students at secondary school level in 2018 [18], of which 48% were young men, 50% young women and 0.9% reported their gender to be 'other' (Table I). The majority of participants were between 15 and 19 years old, and 7.5% were over the age of 19 years. Participants' mean age was 17.3 years (Table I). The total number of those answering the question on AAS use was 9737.

#### Demographic information

As an indicator of socioeconomic status, participants answered questions on their living arrangements (i.e. if they lived with both biological parents, mother and stepfather, or if they lived alone, etc.) and their parents' level of education.

#### Measures

**AAS use.** The intake of AAS was assessed with the following question: How often have you used AAS? Answer categories were throughout their life: 'never', '1–2 times', '3–5 times', etc. up to '40 times or often'. A dichotomous dummy variable was created with 0 being has never used AAS, and 1 being has used AAS.

**Anger.** Anger was assessed with five questions from the anger subscale of the symptom checklist 90 (SCL-90) [19] asking about anger during the past 30 days. An example of a question is, 'did you experience temper outbursts that you could not control'. Answers were on a four-point response scale ranging from 'never' to 'often'. Item responses were summed,

such that higher scores indicated higher levels of self-reported anger. These items have previously been used to measure anger and had good validity and high factor loadings [20]. Cronbach's alpha was used to evaluate internal consistency,  $\alpha=0.83$ .

**Anxiety.** Anxiety was assessed with the general anxiety disorder 7-item scale (GAD-7) [21]. GAD-7 is a seven-item questionnaire that assesses general anxiety symptoms. Answers for each question are on a four-item response scale. Reliability and validity have been reported to be good in the Icelandic population [22]. Cronbach's alpha was used to evaluate internal consistency,  $\alpha=0.91$ .

**Body image.** Body image was evaluated with five questions from the body and self-image subscale of the Offer Self Image Questionnaire (OSIQ) [23]. Participants were asked how well they agreed with the statements about their appearance. All items were rated on a four-point response scale, where 1 was 'not at all true of me', and 4 was 'true of me'. Higher scores reflect a better body image. The scale has been used previously and had good validity [24]. Cronbach's alpha was used to evaluate internal consistency,  $\alpha=0.83$ .

**Depression.** Depression was assessed with a 10-item depression subscale from the Symptom Checklist 90 (SCL-90) [19]. It is scored on a four-point Likert scale rated from 1 (seldom) to 4 (often), asking about feelings of depression in the preceding week. An example of a question is, 'Did you feel that the future is hopeless'. The use of this subscale has been published [20] and has acceptable validity. Cronbach's alpha was used to evaluate internal consistency,  $\alpha=0.91$ .

**Self-esteem.** Self-esteem was assessed with the widely used Rosenberg self-esteem scale [25,26]. The scale consists of 10 statements, each rated as negative or positive, with four response options ranging from 'strongly agree' (4) to 'strongly disagree' (1). Reliability

and validity have been reported to be good in the Icelandic population [27]. Cronbach's alpha was used to evaluate internal consistency,  $\alpha=0.91$ .

*Suicide attempt.* Suicide attempt was assessed with two questions: 'Have you ever attempted suicide?' and 'Have you ever attempted suicide during the past 12 months?'. Response options were 'yes' and 'no'.

*Substance use.* Information was collected on alcohol intoxication, the use of narcotics (cannabis and cocaine) and the use of prescription drugs (for depression, anxiety, attention deficit hyperactivity disorder (ADHD) and sleeping problems) any time during their lifetime. Answer categories were the same as for AAS use described above.

*Lifestyle measures.* Participants were asked how often per week they participate in organised and/or non-organised sports, and if they were trying to lose or gain weight or whether they felt too thin, too fat or neither. Participants also answered a question on whether their learning in school had suffered due to ADHD.

#### Statistical analysis

Descriptive summaries are presented as means and standard deviations for continuous variables and as frequencies for percentages for categorical variables. Study variables were analysed for distributional properties. The alpha level for significant differences is set at 0.05.

To assess differences between AAS users and non-users, an independent-samples *t*-test was used for continuous variables and a  $\chi^2$  test for categorical variables. To compare differences between two means, Cohen's *d*, an effects size, was calculated. Binary logistic regression was used to assess the relationships between mental health and AAS use.

## Results

The total number of participants that have ever used AAS was 155 (1.6%), of which 78% were young men, 16% young women, and 6% of users reported their gender as 'other' (Table II). No difference was found in the age of AAS users and non-users (Table II). Parents of AAS users had a lower level of education than those of non-users. Of fathers who had a university degree, 0.9% were the father of an AAS user,  $\chi^2 (4, 8899) = 17.3$ ,  $P=0.004$ . Of mothers who had a university degree, 1.1% were the mother of an AAS user,  $\chi^2 (4, 8835) = 17.1$ ,  $P=0.004$ . A lower proportion (43%) of AAS users compared to non-users (65%) lived with both parents. A higher proportion of AAS users (19%) lived on their own compared to non-users (4%).

Table II. Differences in age and mental health by use and non-use of AAS<sup>1</sup>.

	Never used AAS				Have used AAS				Total ( <i>n</i> )	<i>t</i> -value	<i>P</i> value for all users and non-users	Cohen's <i>d</i>	
	Male		Female		Male		Female						
	Other <sup>1</sup>	All genders	Other <sup>1</sup>	All genders	Other <sup>1</sup>	All genders	Other <sup>1</sup>	All genders					
N	4528	4955	68	17.2 (1.1)	17.2 (1.3)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)
Age	17.3 (1.2)	17.2 (1.1)	17.2 (1.3)	17.2 (1.1)	17.2 (1.3)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)	17.2 (1.1)
Anxiety	11.1 (4.4)	14.0 (5.2)	15.7 (6.3)	12.7 (5.1)*	15.7 (6.3)	12.7 (5.1)*	15.7 (6.3)	12.7 (5.1)*	15.7 (6.3)	12.7 (5.1)*	15.7 (6.3)	12.7 (5.1)*	15.7 (6.3)
Depression	22.4 (8.5)	26.8 (9.3)	31.6 (10.9)	24.8 (9.2)*	31.6 (10.9)	24.8 (9.2)*	31.6 (10.9)	24.8 (9.2)*	31.6 (10.9)	24.8 (9.2)*	31.6 (10.9)	24.8 (9.2)*	31.6 (10.9)
Body image	15.2 (3.4)	13.6 (3.5)	12.2 (4.1)	14.4 (3.6)	12.2 (4.1)	14.4 (3.6)	12.2 (4.1)	14.4 (3.6)	12.2 (4.1)	14.4 (3.6)	12.2 (4.1)	14.4 (3.6)	12.2 (4.1)
Self-esteem	31.7 (6.6)	29.4 (6.9)	24.0 (7.0)	30.5 (6.9)*	24.0 (7.0)	30.5 (6.9)*	24.0 (7.0)	30.5 (6.9)*	24.0 (7.0)	30.5 (6.9)*	24.0 (7.0)	30.5 (6.9)*	24.0 (7.0)
Anger issue	8.7 (3.4)	9.2 (3.5)	10.3 (4.4)	8.9 (3.5)*	10.3 (4.4)	8.9 (3.5)*	10.3 (4.4)	8.9 (3.5)*	10.3 (4.4)	8.9 (3.5)*	10.3 (4.4)	8.9 (3.5)*	10.3 (4.4)

All variables are reported as means (std) and effects size calculated with Cohen's *d*.

AAS: anabolic androgenic steroids.

<sup>1</sup>Those who define their gender not as male or female.

\*Significant difference found.

### Mental health

The mental health and ages of AAS users compared to non-users are reported in Table II. More anger issues, anxiety symptoms and depression symptoms were found in AAS users, and their self-esteem was lower compared to non-users. No difference was found in body image score between users and non-users (Table II).

A total of 1035 participants had tried to take their own lives, and 434 had tried in the previous 12 months. Reports of attempted suicide were higher among AAS users than non-users (Figure 1), both for those who had tried it at any point during their lifetime  $\chi^2 (1, 9580) = 57.5, P < 0.001$  and for those who had attempted it in the preceding 12 months  $\chi^2 (1, 9578) = 76.4, P < 0.001$ .

### Prescription drug and substance use

A larger proportion of AAS users than non-users reported taking medicine for depression, anxiety,

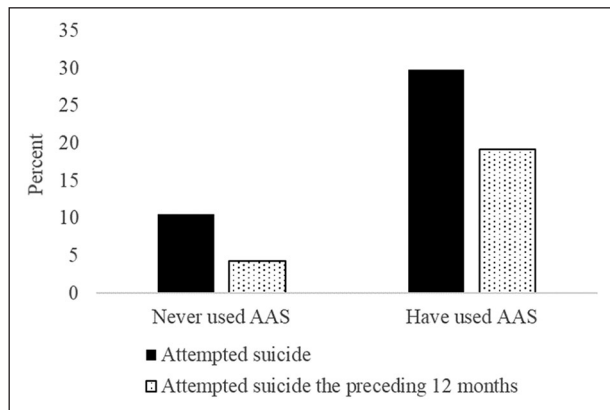


Figure 1. Participants reporting 'yes' to ever having attempted suicide and 'yes' to having attempted suicide during the preceding 12 months.

ADHD and sleeping problems (Table III). A larger proportion of AAS users compared to non-users had used cannabis more than two times and had become intoxicated by alcohol two times or more. All participants who had used cocaine more often than two times were AAS users (Table III).

### Lifestyle

A larger proportion of AAS users participated in non-organised sports, 48%, than non-AAS users, 31% (Table III). A larger proportion of AAS users (30%) compared to non-users (15%) believed that they were too thin, and a larger proportion of AAS users (31%) than non-users (19%) were trying to gain weight. A higher proportion of AAS users than non-users reported that ADHD (81% vs. 59%) had made their school education difficult (Table III).

### Association between mental health and AAS use

Mental health variables associated with higher odds of AAS use were increased anger and increased body image score (Table IV, model 1). After adjusting for covariates, anger issues were associated with higher odds of AAS use along with male gender, a lower education level of the mother and participation in non-organised sports (see model 2 in Table IV).

### Discussion

The main findings of this study were that the prevalence of AAS was 1.6%. Men were 78% of users. AAS users had more mental health problems compared to non-users. Reports of attempted suicide were strikingly high among AAS users. A larger proportion of AAS users reported taking prescription drugs. They were also more likely to be polysubstance abusers

Table III. Proportional differences between AAS users and non-users on various study variables.

	AAS user (%)	Non-AAS user (%)	$\chi^2(df)$	<i>P</i> value
Use of medicine for				
Depression	30	7	108.4 (1)	0.001
Anxiety	23	9	29.2 (1)	0.001
ADHD	26	8	62.1 (1)	0.001
Sleep	24	7	62.1 (1)	0.001
Used cannabis two times or more	47	4	686.3 (1)	0.001
Used cocaine two times or more	76	0	7336 (1)	0.001
Have been drunk two times or more	84	43	104.7 (1)	0.001
Education difficulties due to ADHD	81	58	31.8 (1)	0.001
Participate in non-organised sports	48	31	19.6 (1)	0.001
Believe they are too thin	30	15	29.6 (1)	0.001
Are trying to gain weight	31	19	16.9 (1)	0.001

AAS: anabolic androgenic steroids; ADHD: attention deficit hyperactivity disorder.



Table IV. Association of mental health variables and covariates with odds of using AAS.

	Model 1 unadjusted <sup>1</sup>		Model 2 adjusted <sup>2</sup>	
	N	OR (95% CI)	N	OR (95% CI)
<b>Mental health variables</b>				
Anger	133	<b>1.13 (1.07–1.19)*</b>	89	<b>1.10 (1.03–1.18)*</b>
Anxiety	133	1.03 (0.98–1.08)	89	1.06 (0.99–1.13)
Body image	133	<b>1.13 (1.05–1.21)*</b>	89	1.01 (0.93–1.10)
Depression	133	1.01 (0.98–1.05)	89	1.04 (0.99–1.09)
Self-esteem	133	0.98 (0.94–1.02)	89	1.04 (0.99–1.09)
<b>Covariates</b>				
Gender			89	<b>0.14 (0.09–0.25)*</b>
Mother's level of education			89	<b>0.77 (0.64–0.91)*</b>
Father's level of education			89	0.89 (0.74–1.63)
Participation in non-organised sports			89	<b>2.47 (1.47–4.16)*</b>

\* $P < 0.05$ .

CI: confidence interval; OR: odds ratio.

<sup>1</sup>Model 1 unadjusted.<sup>2</sup>Model 2 includes all mental health variables as well as covariates.

compared to non-AAS users. Finally, increased anger and body image scores were the only mental health variables associated with increased odds of using AAS. However, the highest odds of increased AAS use were associated with participation in non-organised sports.

The prevalence of AAS use found in this study is similar to previous findings from the Nordic countries [9]. In this study, the socioeconomic status of AAS users was lower than in non-users as their parents' education level was lower, more lived with a single parent or lived on their own compared to non-AAS users. Although the education level of both parents of AAS users was lower than for parents of non-AAS users, only mothers' low education level was associated with higher odds of AAS use. It could be speculated that the reason for this is that AAS users were more likely to live with a single parent, which is usually the mother. Other studies have not found an association between AAS use and parents' level of education [28]. The typical AAS abuser has been described as a male polysubstance abuser being more likely to take other illegal performance-enhancing drugs, with poor academic performance, low self-esteem and a history of disordered conduct [6,13]. This description is in accordance with our results, with the majority of AAS users being men and being more likely to be prescribed drugs for mental health problems and use illegal substances. Of note, only AAS users had used cocaine, and 81% of them had had education difficulties due to ADHD.

#### *Mental health and AAS use*

At the beginning of AAS use, users have reported their self-esteem being enormously boosted, as well

as hyperactivity and reckless behaviour. After a while, irritability and aggressiveness appear in addition to a hypomanic and psychotic state. Hardly any foresee the dependency on AAS that develops [1]. Tragically, case reports from the general population on the intake of AAS have revealed sad stories of young individuals who end their lives after being diagnosed with a substance-induced mood disorder following AAS use [29]. The reports on attempted suicide in our study are alarming, with 10% of all participants reporting that they had attempted suicide. Of those using AAS, almost 30% had tried taking their own life and 19% reported a suicide attempt during the previous 12 months. A systematic review [30] on AAS use and psychopathology in athletes indicates that users are highly suicidal.

The largest effect size found in the difference of mental health between AAS users and non-users was for anger, followed by anxiety and depression. Of the mental health variables, anger had the strongest association with increased odds of using AAS both before and after adjusting for covariates. These results mirror that from the literature review on anger issues in AAS users [1]. Speculations on why only anger but not the other mental health variables associated with higher odds of AAS use after adjusting for covariates might be due to doses and duration of AAS usage. Perhaps aggressive behaviour arises with a low dosage of AAS with intake for a short period of time, whereas AAS needs to be taken for a long time, perhaps with no brakes, or in higher dosages to affect mood. On the other hand, studies have revealed that depression and anxiety are related to withdrawal of AAS use but not to the increased use of AAS [1,5]. No difference was found between AAS users' and non-users' body image scores. However, a larger proportion of AAS users,

compared to non-users, believed that they were too thin or were trying to gain weight. Their body image score was also one of two mental health variables associated with increased odds of using AAS.

#### *Strengths, limitations and directions for future research*

To the best of our knowledge, this is among the first population-based studies on AAS use among young individuals that compares users' mental health to that of non-users. It gives a good description of use among the general public and their mental health. The questions on AAS were self-reports and a part of a comprehensive questionnaire and were thus less specific. It could well be that the prevalence of AAS use is under-reported as it is an illegal act.

In the future, it would be interesting to get answers to more detailed questions on AAS use; for example, on the motivation for intake, whether intake is monitored, how users obtain their AAS, for how long they have been using and if they believe AAS use is harmless.

#### **Conclusion**

AAS use is a public health threat. Although the use among elite athletes has received the most debate, they are clearly no longer used only for performance enhancement in sports. They are more likely to be used for appearance enhancement by young individuals. AAS use has had an alarming effect on the lives of individuals who report having used them. As found in this study, the mental health of AAS users was worse than that of non-users, they were more likely to have attempted suicide and used other substances. Increased education about the adverse health effects of AAS use is needed for the general public; for example, for parents to monitor their youngsters for rapid weight gain or muscle growth and other biological changes, as well as extreme fluctuations in their mental health. To reduce future negative implications of AAS use, increased awareness is vital among authorities, physicians, psychologists and others in the medical community of the signs, symptoms and danger of AAS use.


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