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Adolescent Anabolic-Androgenic Steroid Use in Association with Other Drug Use, Injection Drug Use, and Team Sport Participation

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Abstract

Introduction.—The majority of epidemiologic research on adolescent non-medical anabolic-androgenic steroid (AAS) use was conducted in the 1990s and early 2000s, indicating a need to update evidence for the modern era. We aim to understand the prevalence of AAS use among US adolescents and assess associations between AAS use, sports participation, other drug use, and injection drug use (IDU).

Methods.—Using data from the 2017 National Youth Risk Behavior Survey, we estimated the prevalence of AAS use and tested for associations between AAS use, sports participation, and drug use, overall and by sex.

Results.—The prevalence of AAS use was 2.98%. The prevalence among boys (3.46%) was higher than among girls (2.41%). AAS use was high among youth with lifetime heroin use (64.41%) and IDU (64.42%). There was no association between AAS and team sport participation (p=0.61).

Conclusions.—Our results indicate that adolescent AAS use is an aspect of polysubstance use rather than a substance used solely for performance enhancement in sports. Research with adolescents should be mindful of the overlap of heroin and AAS use among youth with IDU.

Keywords

anabolic-androgenic steroids; injection drug use; adolescents; Youth Risk Behavior Survey

1. Introduction

Much of the research on adolescent anabolic-androgenic steroid (AAS) use in the United States (US) was conducted in the 1990s and early 2000s. That work is now twenty years old and may be less relevant to the current drug landscape, which is broadly defined by the opioid crisis in tandem with an era of cannabis legalization. It is important to broaden knowledge about the current epidemiology of AAS use. National survey data show approximately 1.6% of 12th graders report lifetime use of AAS (National Institute on Drug Abuse, 2019). Repetitive use has serious health consequences, such as psychiatric,

cardiovascular, hepatic, and reproductive disorders (Horwitz et al., 2019; Kerr and Congeni, 2007). Infections are possible because injection is a common route of administration (Rich et al., 1999). Understanding the modern epidemiology of adolescent AAS use is essential for crafting recommendations for screening and intervention by health care providers.

Multiple explanations for AAS use have been proposed. Some suggest that use reflects a desire for enhanced athletic performance or muscle growth, whereas others indicate use due to body image concerns (Jampel et al., 2016; Komoroski and Rickert, 1992). Some have further highlighted disparities by sexual orientation, particularly among Black and Hispanic boys (Blashill, et al., 2017). Other work has suggested that AAS use is part of a larger pattern of risk behaviors among adolescents (Bahrke et al., 2000; Miller et al., 2002; Miller et al., 2005). Recent research has supported this understanding by showing that AAS use may be part of a broader polysubstance use profile among adolescents that includes injection drug use (IDU) (Schneider et al., 2020a). Research has suggested that IDU may be increasing among adolescents in some urban settings due to the opioid epidemic, raising the concern that other substance use, including AAS use, may also increase as a part of this phenomenon (Brighthaupt et al., 2019).

Understanding motivations for adolescent AAS use has important implications for screening and intervention. Therefore, we estimate the prevalence of AAS use among a nationally representative sample of US adolescents, overall and stratified by sex. Analyses were stratified by sex as existing literature on adolescent substance use strongly indicate sex differences. We then explore associations between AAS use and other drugs, IDU, and sports participation to understand if AAS is more related to desired athletic performance or a more generalized pattern of substance use.

2. Methods

Data are from 2017 National Youth Risk Behavior Survey (YRBS), a nationally representative, school-based survey of US high school students (9^{th}-12^{th} grade; age: M(SD)=15.96 (1.26)).[5] We included all students who completed the survey and answered the question about AAS use (unweighted N=12,068; sex: boys *n*=5,816, girls *n*=6,157, *n*=127 missing; race/ethnicity: White *n*=6,261, Black *n*=2,796, Hispanic/Latino *n*=3,647, other *n*=1,724). We used a binary measure of lifetime AAS use, based on whether they endorsed using *"steroid pills or shots without a doctor's permission*." Additional study variables included binary measures of lifetime IDU (i.e., *"used a needle to inject any illegal drug"*); lifetime use of alcohol, marijuana, cocaine, methamphetamine, prescription pain relievers (non-medical), and heroin; and past 12-month team sport participation. We conducted design-adjusted chi-square tests to estimate associations between AAS use and the other study variables, for the full sample and by sex. We also estimated design-adjusted polychoric correlations to compare the strength of association by sex. This study was considered exempt by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

3. Results

Approximately 3% of adolescents reported AAS use. Use was slightly higher among boys (3.46%, 95% CI: 2.83, 4.08) than girls (2.41%, 95% CI: 1.96, 2.88; F=7.17, p=0.008). AAS use did not differ by grade level. Use was lower among White adolescents than adolescents of other races in the overall sample and among girls, but there were no significant differences by race among boys. Associations of AAS use with use of individual drugs and with IDU were strong and statistically significant, both overall and when stratified by sex (Table 1). Across drugs, the strength of association with AAS was larger among boys than girls, except for marijuana and prescription pain relievers where associations were similar. AAS use was particularly high among youth who reported heroin use (64.4%) and IDU (62.4%). Only 2.15% of adolescents who used AAS reported using no alcohol or other drugs (6.19% when only considering other drugs). We did not observe an association between lifetime AAS use and past 12-month team sport participation.

4. Discussion

Approximately 3% of US high school students report AAS use, indicating that the prevalence of use is on par with illicit drugs like cocaine (4.8%), methamphetamine (2.5%) and heroin (2.9%) (Kann et al., 2018). This estimate is higher than was observed in the Monitoring the Future (MTF) study (1.6% of 8^{th}-12^{th} graders in their lifetime) (Miech et al., 2019). The YRBS consistently produces higher estimates of substance use than MTF, likely due to methodological differences (Gfroerer et al., 2012). One key methodological factor that may contribute to these differences include that the YRBS embeds substance use questions within a range of questions about other health behaviors, making substance use a less prominent aspect of the survey.

As with most substances, AAS use varied by sex and race/ethnicity. Use was higher among boys than girls (3.46% vs. 2.41%), a finding that is consistent with previous studies (Bahrke et al., 2000). Hispanic/Latino youth had the highest prevalence of AAS use, followed by Black youth. White adolescents were less likely to use AAS than adolescents of other races; sex differences were particularly apparent among girls. We explored race differences could be due to disproportionate engagement in team sports, but findings did not provide any indication for this. The reasons for race differences in AAS use are not known and require further investigation.

Differences by race were small compared to associations with other substance use. The concordance of AAS use and stimulant use (cocaine, methamphetamine) and IDU appeared to be stronger among boys than girls. This finding is consistent with adult studies, some of which conclude that motivation for concurrent use of AAS and stimulants in men is driven by the goal to look slim and muscular, rather than for enhancing performance in sports (Zahnow et al., 2020). This suggests that co-use of AAS and stimulants may be a useful marker for identifying boys at risk for unhealthy weight loss behaviors, a topic warranting further research.

We did not observe a relationship between AAS use and participation in team sports. This finding contrasts with previous work that indicates AAS use is higher among student athletes, particularly male athletes who participate in competitive sports, such as football (Boyce, 2003). However, our findings are consistent with some previous work that did not detect an association between sports participation or strength conditioning and adolescent AAS use (Miller et al., 2005). The lack of association in this study could reflect an actual absence of association but could also be an artifact of variation in the type and nature of team sports or in the quality of coaching and adult monitoring, which we were unable to assess in this study (Elkins et al., 2016). We also did not assess participation in individual sports, which may also contribute to the lack of association. It is also possible that the different time frame of measurement for the sports participation and steroid use played a role.

There were strong associations between AAS use and use of other drugs, lending credence to the idea that AAS use is part of a broader pattern of adolescent polysubstance use. Few adolescents reported using AAS and no other drugs. AAS use had the lowest concordance with alcohol and marijuana, likely reflecting the comparatively high rate of using alcohol or marijuana and relative normalization of use among adolescents (Hathaway et al., 2011; Substance Abuse and Mental Health Services Administration, 2015). In other words, there are likely many adolescents who use alcohol or marijuana but no other drugs, reducing the association between these substances and AAS use.

AAS had the strongest associations with heroin use and IDU, as more than 60% of adolescents who reported AAS also reported these behaviors. Most recent research on adolescent IDU has focused exclusively on opioids (Brighthaupt et al., 2019; Rajan et al., 2018). Our results suggest that this focus needs to be broadened to address polysubstance injection among adolescents, including AAS use, in both research and clinical practice. Adult research has documented significant harms associated with polysubstance use, including increased HIV risk through sexual and injection related risk behaviors and higher overdose risk (Harrell et al., 2012; Morley et al., 2015; Roth et al., 2015; Schneider et al., 2020b; Schneider et al., 2020c; Wu et al., 2011). Comparable research among adolescents is needed to understand any risks specific to this age group. Further, clinicians, in both primary care and specialty settings, should incorporate routine screenings for AAS and other drug use among adolescents in their care. AAS use is rarely reported to physicians (Pope, et al., 2004), so screenings are one tool to solicit reporting and initiate interventions. Several evidence-based treatments exist for AAS and associated physical health conditions (Kanayama, et al., 2010), and intervention-referral models (i.e., SBIRT, STIR; Bernstein & D'Onofrio, 2017) may be useful for primary care clinicians who are not comfortable treating AAS use in their practice.

This study has the following limitations to consider. As discussed above, the measure of sports participation was limited, so we cannot conclusively state that there is no association with AAS use. We were also unable to measure other forms of exercise that AAS use could be relevant to, such as weightlifting or individual sports. We were further unable to measure body image in this study, a theoretical motivation for AAS use that warrants further exploration. The measures of substance use are also limited as they are binary lifetime

indicators. Further research is needed to understand what proportion of adolescents have used AAS recently or use AAS on a regular basis.

Our findings highlight the importance of understanding AAS use within the broader context of adolescent polysubstance use and the current opioid epidemic. Increased attention to AAS use may be warranted in prevention programs and harm reduction strategies that address heroin and IDU.

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Table 1.

Anabolic-Androgenic Steroid (AAS) Use in Association with Other Drug Use, Injection Drug Use, and Team Sport Participation among US High School Students, 2017

		Full Sample (N=12,068)				Boys (n=5,816)				Girls (n=6,157)			
		AAS	**No AAS**	**F, *p*-value**	**rho, S.E.**	**AAS**	**No AAS**	**F, *p*-value**	**rho, S.E.**	**AAS**	**No AAS**	**F, *p*-value**	**rho, S.E.**
Total		2.98%	97.04%	--	--	3.46%	96.54%	--	--	2.41%	97.58%	--	--
Grade	9th	2.88%	97.12%	0.625, 0.598	0.01, 0.01	2.91%	97.09%	0.905, 0.437	0.06, 0.01	2.87%	97.13%	0.613, 0.607	−0.05, 0.04
	10th	2.56%	97.44%			2.95%	97.05%			2.19%	97.81%		
	11th	3.32%	96.68%			4.09%	95.91%			2.28%	97.72%		
	12th	2.91%	97.09%			3.74%	96.26%			2.06%	97.94%		
Race/ Ethnicity	White	2.28%	97.72%	3.88, 0.009	--	2.98%	97.02%	1.88, 0.133	--	1.64%	98.36%	3.153, 0.024	--
	Black	3.40%	96.60%			3.77%	96.23%			2.74%	97.26%		
	Hispanic	3.93%	96.07%			4.68%	95.32%			3.21%	96.79%		
	Other	3.00%	97.00%			3.46%	97.47%			3.20%	96.80%		
Alcohol	Yes	4.05%	95.95%	94.41, <0.001	0.44, 0.04	4.92%	95.08%	65.32 <0.001	0.51, 0.06	3.23%	96.77%	30.75, <0.001	0.36, 0.07
	No	0.54%	99.46%			0.46%	99.54%			0.64%	99.36%		
Marijuana	Yes	6.08%	93.92%	225.94, <0.001	0.49, 0.03	7.27%	92.73%	129.52, <0.001	0.51, 0.03	4.85%	95.15%	103.54, <0.001	0.47, 0.06
	No	0.80%	99.20%			0.96%	99.04%			0.65%	99.35%		
Cocaine	Yes	26.94%	73.06%	800.60, <0.001	0.67, 0.02	31.04%	68.96%	490.59, <0.001	0.70, 0.02	19.94%	80.06%	243.22, <0.001	0.59, 0.07
	No	1.83%	98.17%			1.98%	98.02%			1.68%	98.32%		
Methamphetamine	Yes	47.45%	52.55%	1359.28, <0.001	0.78, 0.02	51.62%	48.38%	871.09, <0.001	0.82, 0.03	34.65%	65.35%	333.71, <0.001	0.66, 0.05
	No	1.93%	98.07%			1.95%	98.05%			1.93%	98.07%		
Inhalants	Yes	21.71%	78.28%	752.31, <0.001	0.64, 0.02	29.33%	70.67%	618.01, <0.001	0.71, 0.03	13.85%	86.15%	178.97, <0.001	0.53, 0.04
	No	1.70%	98.30%			1.18%	98.19%			1.62%	98.38%		
Prescription Pain Relievers	Yes	14.52%	85.48%	628.99, <0.001	0.65, 0.02	18.22%	81.78%	369.60, <0.001	0.68, 0.04	11.06%	88.94%	270.24, <0.001	0.62, 0.02
	No	1.06%	98.94%			1.24%	98.76%			0.85%	99.15%		
Heroin	Yes	64.41%	35.59%	2004.06, <0.001	0.85, 0.02	62.25%	37.75%	1123.87, <0.001	0.85, 0.03	63.71%	36.29%	650.54, <0.001	0.81, 0.04
	No	1.93%	98.07%			2.01%	97.99%			1.88%	98.12%		
Injection Drug Use	Yes	62.42%	37.58%	1592.96, <0.001	0.82, 0.02	65.95%	34.05%	1014.54, <0.001	0.85, 0.03	49.47%	50.53%	387.99, <0.001	0.72, 0.06
	No	2.10%	97.90%			2.21%	97.79%			2.03%	97.97%		

		Full Sample (N=12,068)				Boys (n=5,816)				Girls (n=6,157)			
		AAS	**No AAS**	**F, *p*-value**	**rho, S.E.**	**AAS**	**No AAS**	**F, *p*-value**	**rho, S.E.**	**AAS**	**No AAS**	**F, *p*-value**	**rho, S.E.**
Team Sport Participation	Yes	3.03%	96.97%	0.26, 0.610	0.02, 0.02	3.75%	96.25%	1.94, 0.164	0.07, 0.05	2.22%	97.78%	0.90, 0.344	−0.05, 0.04
	No	2.84%	97.16%			2.92%	97.08%			2.67%	97.34%		

Note. Rho assess the strength of association between AAS use and the given substance/variable.