Sexual Orientation and Anabolic-Androgenic Steroids in US Adolescent Boys

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KEY WORDS

sexual orientation, anabolic-androgenic steroids, adolescents, boys

ABBREVIATIONS

AAS—anabolic-androgenic steroid

CI—confidence interval

OR—odds ratio

SMM—simultaneous multiple mediation

YRBS—Youth Risk Behavior Survey

Dr Blashill conceptualized and designed the study, conducted the analyses, and drafted the initial manuscript; Dr Safren supervised all aspects of the study and provided editorial comments on the initial drafts of the manuscript; and both authors approved the final manuscript as submitted.

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WHAT'S KNOWN ON THIS SUBJECT: Anabolic-androgenic steroid misuse is not uncommon among adolescent boys, and initial use in adolescence is associated with a host of maladaptive outcomes, including cardiovascular, endocrine, and psychiatric complications.

WHAT THIS STUDY ADDS: This is the first known study to examine prevalence rates of anabolic-androgenic steroid misuse as a function of sexual orientation. A dramatic disparity was found, in that sexual minority boys reported misuse at a much higher rate than heterosexual boys.

abstract

OBJECTIVES: We compared the lifetime prevalence of anabolic-androgenic steroid (AAS) misuse among sexual minority versus heterosexual US adolescent boys, and secondarily, sought to explore possible intermediate variables that may explain prevalence differences.

METHODS: Participants were 17 250 adolescent boys taken from a pooled data set of the 14 jurisdictions from the 2005 and 2007 Youth Risk Behavior Surveys that assessed sexual orientation. Data were analyzed for overall prevalence of AAS misuse and possible intermediary risk factors.

RESULTS: Sexual minority adolescent boys were at an increased odds of 5.8 (95% confidence interval 4.1–8.2) to report a lifetime prevalence of AAS (21% vs 4%) compared with their heterosexual counterparts, $P < .001$. Exploratory analyses suggested that increased depressive symptoms/suicidality, victimization, and substance use contributed to this disparity.

CONCLUSIONS: This is the first known study to test and find substantial health disparities in the prevalence of AAS misuse as a function of sexual orientation. Prevention and intervention efforts are needed for sexual minority adolescent boys. *Pediatrics* 2014;133:469–475

Anabolic-androgenic steroids (AAS) are a group of substances, including testosterone and synthetic derivatives, that aid in the synthesis of protein and increase the development of secondary male sex characteristics.¹ Although these substances are used for a variety of reasons, the most common reasons are to enhance strength, performance, and/or muscularity.² Long-term consequences of AAS misuse include cardiovascular, endocrine, and psychiatric complications.^{3,4} General population estimates suggest that AAS misuse is not uncommon among adolescent boys, with prevalence rates varying between 1.0% and 5.4%,^{5,6} and nearly one-quarter of adult men who misuse AAS report initial use during adolescence.⁷

One population that may be at an increased risk of misusing AAS is sexual minority (gay and bisexual) boys. Sexual minorities are at an increased risk for a variety of maladaptive outcomes, including substance use,^{8–10} depression,¹¹ victimization,^{12–14} suicidality,^{9,11,15} and body image dissatisfaction.¹⁶ There are likely a number of reasons to explain these health disparities, with one prominent theory being the sexual minority stress model.^{17,18} This theory posits that sexual minorities are at increased risk for poor health outcomes via discrimination, victimization, stigma, and internalized homophobia. Hatzenbuehler¹⁹ has extended this theory to address the question of how these macro-level forces affect the health of sexual minorities. He suggests that macro-level stressors impact negative health outcomes for sexual minorities through the mechanisms of emotion dysregulation, social/interpersonal problems, and maladaptive cognitive processes.²⁰

Many of these sexual orientation–based health disparities are also known risk factors for AAS misuse. For instance, elevated depressive symptoms/suicidality,^{5,21}

substance use,^{2,5,22–25} and increased victimization^{5,21,26,27} have been linked to AAS misuse. Indeed, recent data from a US nationally representative sample of adolescent boys revealed that substance use, depressive symptoms/suicidality, and victimization were strongly related to AAS misuse.^{28,29} Some have argued that depressive symptoms/suicidality may lead to AAS misuse, as boys may experience increased depression as a function of perceiving their bodies as inconsistent with current Western ideals for males (ie, high muscularity and low body fat), which are unattainable for most boys. This discrepancy in ideal versus actual physique may be associated with the misuse of AAS, with aims of gaining increased muscle mass. Similarly, boys who are bullied or victimized may desire a highly muscular body in hopes that greater muscle mass would deter others from victimizing them.²⁸ Last, substance use is strongly related to AAS misuse,³⁰ and it has been suggested that AAS misuse falls within a broader cluster of polysubstance use.

To date, there have been no known examinations of the prevalence of AAS misuse as a function of sexual orientation, and focusing on adolescent boys is of particular significance due to the literature reviewed previously, suggesting that this is a developmental window when AAS misuse seems to begin for a sizable proportion of boys. Thus, the current study sought to assess the prevalence of lifetime misuse of AAS as a function of sexual orientation among a national sample of US adolescent boys (ie, Youth Risk Behavior Survey [YRBS]). Further, to begin to explore possible mechanisms underlying any differences, we statistically examined the role of depressive symptoms/suicidality, victimization, and substance use.

METHODS

Participants and Procedure

Participants were 17 250 adolescents, of whom 635 (3.7%) were classified as sexual minorities (see Table 1 for sample characteristics). The study analyzed a data set that pooled 2005 and 2007 YRBSs^{31,32} from the 14 jurisdictions (Boston, Chicago, Connecticut, Delaware, Hawaii, Maine, Massachusetts, New York City, San Diego, San Francisco, Vermont, Rhode Island, Wisconsin, and Milwaukee), as these were the only jurisdictions in the United States that included 1 or more measures of sexual orientation (data from Vermont were included in the primary, but not the exploratory analyses, as this jurisdiction did not assess suicidality which was used in the exploratory analyses). The general approach to pooling the data and analyzing the pooled data set, along with the sexual orientation items and characteristics of the sample by jurisdiction, are described in detail in Mustanski et al.³²

Measures

Sexual Orientation

Because the goal of this project was to present a broad epidemiologic view of AAS misuse among sexual minority adolescents in the United States, a pooled sexual orientation variable was created that allows for inclusion of as many jurisdictions as possible in the analysis sample. A binary Sexual Minority Status variable was created to identify individuals who endorsed a minority sexual orientation on any of the 3 dimensions measured (“gay or lesbian” or “bisexual” in Sexual Orientation Identity, “exclusive same sex” or “same and opposite sex” in Gender of Sexual Partners, and “attracted to same sex” or “bisexually attracted” in Gender of Sexual Attraction). Nine of 14 jurisdictions included a question about sexual orientation identity; 12 of 14 jurisdictions included a question about

TABLE 1 Characteristics of the Study Population

Variable	Sexual Minority	Heterosexual	Total
AAS misuse, percentage (frequency)			
Any ^a	21 (133)	4.0 (665)	4.0 (693)
Moderate ^b	8 (51)	1.5 (249)	1.7 (300)
Severe ^c	4 (25)	0.7 (116)	0.8 (141)
Race/Ethnicity, %			
White	35	38	38
Black/African American	26	22	22
Hispanic/Latino	14	17	16
Asian	8	13	13
Multiracial/Hispanic	7	5	5
Multiracial/non-Hispanic	4	3	3
Native Hawaiian/Pacific Islander	5	2	2
American Indian/Alaskan Native	2	0.8	0.8
Depression/suicidality, mean (SD) ^d	1.1 (1.3)	0.42 (0.83)	0.45 (0.86)
Victimization, z score, mean (SD)	0.44 (1.3)	−0.01 (0.65)	0.00 (0.70)
Substance use, z score, mean (SD)	0.76 (1.6)	−0.01 (0.70)	0.01 (0.77)
Age, y, mean (SD)	16.1 (1.3)	15.9 (1.3)	15.9 (1.3)

^a 1 or more, $\chi^2(1) = 225.53, P < .001, OR = 5.8, 95\% CI (4.1-8.2)$.

^b 10 or more, $\chi^2(1) = 118.65, P < .001, OR = 5.7, 95\% CI (3.4-9.6)$.

^c 40 or more, $\chi^2(1) = 57.96, P < .001, OR = 5.7, 95\% CI (2.7-11.9)$.

^d Depression/suicidality range: 0 to 4.

the gender of sexual partners, and attraction was measured in only 1 jurisdiction (see Table 2 for all items, responses, and how responses were coded into the Sexual Minority Status variable). Although we acknowledge that constructing the Sexual Minority Status variable out of 3 measures may obscure important variability across dimensions of sexual orientation, combining measures allowed us to use the entire sample to report data on the overall population of sexual minority adolescents.³²

AAS Misuse

Lifetime AAS misuse was assessed with the following item, “During your life, how many times have you taken steroid pills or shots without a doctor’s prescription?” The response options for this item included 0 times, 1 or 2 times, 3 to 9 times, 10 to 19 times, 20 to 39 times, or 40 or more times. A dichotomous score was created by coding no misuse as 0 and responses ≥ 1 or 2 times as 1. Two additional dichotomous variables were created to assess moderate and severe levels of AAS misuse. Moderate use was defined as ≥ 10 , and severe use defined as ≥ 40 .

Depressive Symptoms/Suicidality

Symptoms of depression and suicidality were assessed via 4 individual items, which included feeling sad or hopeless nearly every day for a 2-week period, as well as items assessing suicidal ideation, plans, and attempts over the previous 12 months. All but the latter item (regarding suicide attempts) were responded to via yes/no. The suicide attempts item was dichotomized into none/1 or more, and a total depression score was calculated on the sum of the 4 individual items (as has been done in previous research²⁸), resulting in a possible range of scores of 0 to 4, with higher scores denoting increased depressive symptoms/suicidality. Scale score reliability for the current sample was adequate (Kuder-Richardson-20 = 0.68).

Substance Use

Substance use was assessed via responses on 9 individual variables. These items assessed lifetime use of MDMA (3,4-Methylenedioxymethamphetamine), methamphetamine, heroin, and inhaling glue, in addition to past 30-day use of cocaine, marijuana, alcohol, snuff, and cigarettes. Because questions used different response scales, z scores were

calculated for each item and a composite score was created to obtain a global substance use score, with higher scores denoting increased use. Scale score reliability for the current sample was good ($\alpha = 0.88$).

Victimization

Victimization was assessed via 6 individual items, which included feeling unsafe, being threatened, having property stolen, and getting into fights at school, along with items that assessed fights and injuries from fights outside of school (see Table 3 for items). Because questions used different response scales, z scores were calculated for each item and a composite score was created to obtain a global victimization score, with higher scores denoting greater victimization. Scale score reliability for the current sample was adequate ($\alpha = 0.76$).

History of Asthma

History of asthma was assessed via the self-report item, “Has a doctor or nurse ever told you that you have asthma?” This item was included as a control variable, as some forms of steroids (eg, prednisone, methylprednisolone) are used to treat asthma.

Statistical Analyses

Primary Analysis

The primary analysis was to estimate the prevalence of AAS misuse as a function of sexual orientation in adolescent boys from this data set. Given the complex sampling design inherent to the YRBS administration, the complex samples module of SPSS 21.0 (IBM SPSS Statistics, IBM Corporation, Chicago, IL) was used in conducting the primary analysis. In doing so, the SPSS complex samples module incorporates the weight, stratum, and primary sampling unit variables provided in the public data sets when executing statistical significance tests. Accordingly, to

TABLE 2 Sexual Orientation Items and Responses

Item	Responses	Sexual Minority Status
Sexual orientation identity Which of the following best describes you?	1. Heterosexual (straight) 2. Homosexual (gay or lesbian) 3. Bisexual 4. Not sure 5. None of the above	2, 3, 4
Gender of sexual partners During your life, with whom have you had sexual contact?	1. I have never had sexual contact 2. Females 3. Males 4. Females and males	3, 4
During your life, the person(s) with whom you have had sexual contact is (are)...	1. I have not had sexual contact with anyone 2. Female(s) 3. Male(s) 4. Female(s) and male(s)	3, 4
The person(s) with whom you have had sexual contact during your life is (are).	1. I have not had sexual contact with anyone 2. Female(s) 3. Male(s) 4. Female(s) and male(s)	3, 4
During your life, with whom have you had sexual intercourse?	1. I have never had sexual intercourse 2. Females 3. Males 4. Females and males	3, 4
Gender of sexual attraction Who are you sexually attracted to?	1. Males 2. Females 3. Both males and females 4. I am not sexually attracted to anyone	1, 3

assess the prevalence of AAS use as a function of sexual orientation, 2 (sexual orientation: heterosexual versus sexual minority) by 2 (AAS misuse: yes versus no) χ^2 tests of independence were conducted, with an associated odds ratio (OR). Finally, history of asthma was controlled for in all analyses, as it could potentially be a confounding variable, given that some forms of steroids (eg, prednisone, methylprednisolone) are used to treat asthma.

Exploratory Analyses

To assess possible explanations of why there may be a sexual orientation health disparity with regard to AAS misuse, simultaneous multiple mediation (SMM) was used according to the bootstrapping strategy recommended by Preacher and Hayes.³³ SMM allows researchers to determine not only whether an individual variable meets statistical criteria for mediation conditionally on the presence of other variables in the model, but also whether the

combination of 2 or more variables meets criteria for mediation. One can also determine the relative magnitude of the indirect effects, in essence, comparing mediator variables' unique ability to mediate, above and beyond other mediators in the model.³³

Bootstrapping is a nonparametric statistical approach in which cases from the original data set are randomly re-sampled ($n = 2000$) with replacement, to reestimate the sampling distribution. An indirect effect is considered to be "significant" if zero is not contained between the lower and upper 95% confidence intervals (CIs). Bootstrapping is generally preferred over traditional methods of studying mediation (ie, the Causal Steps Approach and the Product-of-Coefficients Approach³⁴). One important advantage of this approach is that it does not require variables to conform to normal distributions. In the current study, SMM with 95% CIs was conducted via PROCESS, a statistical program compatible with SPSS.^{35,36}

RESULTS

Primary Analysis: Prevalence of AAS

Sexual minority boys were at significantly increased odds of 5.8 (95% CI 4.1–8.2), compared with heterosexual boys, to have a lifetime prevalence of AAS misuse (21% vs 4%). Similarly, sexual minority boys also reported significantly higher levels of moderate (8% vs 1.5%, OR 5.7, 95% CI 3.4–9.6) and severe (4% vs 0.7%, OR 5.7, 95% CI 2.7–11.9) AAS misuse, compared with heterosexual boys (see Table 1).

TABLE 3 Victimization Items

During the past 12 mo, how many times has someone threatened or injured you with a weapon such as a gun, knife, or club on school property?
During the past 12 mo, how many times has someone stolen or deliberately damaged your property such as your car, clothing, or books on school property?
During the past 12 mo, how many times were you in a physical fight?
During the past 30 d, on how many days did you not go to school because you felt you would be unsafe at school or on your way to or from school?
During the past 12 mo, how many times were you in a physical fight in which you were injured and had to be treated by a doctor or nurse?
During the past 12 mo, how many times were you in a physical fight on school property?

Exploratory Analyses

Sexual minority status was significantly associated with increased victimization, increased depressive symptoms/suicidality, and increased substance use. Increased victimization, elevated depressive symptoms/suicidality, and increased substance use, were in turn all associated with increased AAS misuse. When victimization, depressive symptoms/suicidality, and substance use were controlled, the direct effect of sexual minority status on AAS misuse remained significant, but dropped (see Table 4).

To quantify the difference between the total and direct effects, indirect effects of sexual minority status to AAS misuse were tested. The global indirect effect of sexual minority status to AAS misuse through the combined mediators was significant. The depressive/suicidality, the victimization, and the substance use pathways all emerged as significant. However, the substance use pathway was stronger in magnitude than the depressive/suicidality and victimization pathways. The depressive/suicidality and victimization pathways did not differ from each other (see Table 4).

DISCUSSION

The current study was the first known to examine the prevalence rate of lifetime AAS misuse as a function of sexual orientation. Results indicated sexual minority boys were at increased odds of 5.8 to have ever used AAS in their lifetime. Indeed, sexual minority boys reported a prevalence rate of 21% compared with 4% for heterosexual boys. Further, sexual minority boys also reported significantly higher rates of moderate and severe AAS misuse. These results underscore yet another avenue in which a health disparity exists for sexual minorities, particularly as assessed here, in sexual minority youth.

Preliminary analyses were also conducted to assess for variables that may explain the variance in AAS misuse accounted for by sexual minority status. Findings revealed that depressive symptoms/suicidality, victimization, and substance use were significant intermediate variables. When the magnitude of these indirect effects was contrasted, substance use proved to account for the most variance. This finding suggests that polysubstance use may be a salient pathway from

sexual minority status to AAS misuse, and is consistent with previous research revealing that AAS misuse is strongly associated with use of a variety of other substances.^{30,37,38}

Despite the combined intermediate variables accounting for significant variance in the relationship between sexual minority status and AAS misuse, the direct effect was still significant (although substantially reduced). It is therefore possible that there are additional unmeasured variables that account for the variance in this relationship. One salient construct, body dissatisfaction, was not assessed in the YRBS, a limitation of this work. Body dissatisfaction has been shown to be a strong predictor of AAS misuse,⁶ and gay male individuals also tend to report higher levels of body dissatisfaction compared with their heterosexual counterparts.¹⁶ Thus, it seems likely that this would also be an important variable to assess in the relationship between sexual orientation and AAS misuse.

Despite the novel findings from the current study, it is not without limitations. Of note, the design was cross-sectional. Thus, temporal inferences cannot be made, as it is possible that the intermediate variables (ie, depressive symptoms/suicidality, substance use, and victimization) are outcomes rather than precursors of AAS misuse. Similarly, bidirectional relations may exist between these variables. We were also unable to explore the moderating role of rural versus urban living. Evidence from Canada suggests that sexual minority boys who live in rural communities are at increased odds of 7.7 of ever using AAS compared with their urban sexual minority counterparts.³⁹ Thus, future research may wish to explore what psychosocial factors place rural sexual minority boys at risk for AAS misuse. Additionally, the depressive symptoms/suicidality variable included only 4

TABLE 4 Exploratory Analyses

Pathway	B	SE	95% CI	<i>t</i>	<i>P</i>
Sexual Minority → AAS	1.8	0.12	1.5–2.0	15.0	.001
Sexual Minority → Depression/suicidality	0.62	0.03	0.55–0.68	18.5	.001
Sexual Minority → Substance use	0.52	0.02	0.47–0.56	20.9	.001
Sexual Minority → Victimization	0.33	0.03	0.28–0.39	12.8	.001
Sexual Minority → AAS ^a	0.88	0.17	0.54–1.2	5.1	.001
Depression/suicidality → AAS	0.22	0.05	0.12–0.32	4.3	.001
Substance use → AAS	1.4	0.06	1.2–1.4	22.8	.001
Victimization → AAS	0.42	0.05	0.31–0.52	7.9	.001
Indirect effects					
Sexual Minority → (Global ^b) → AAS	0.98	0.10	0.80–1.2		
Sexual Minority → Dep/suicidality → AAS	0.14	0.03	0.07–0.21		
Sexual Minority → Substance use → AAS	0.70	0.08	0.56–0.88		
Sexual Minority → Victimization → AAS	0.14	0.03	0.09–0.20		
Indirect effect contrasts					
Substance use - Depression/suicidality	0.57	0.09	0.41–0.74		
Substance use - Victimization	0.56	0.07	0.43–0.73		
Victimization - Depression/suicidality	0.002	0.04	–0.09–0.10		

Indirect effects are interpreted as "significant" if 0 is not contained between the lower and upper 95% CI.

^a The effect of sexual minority status to AAS misuse, controlling for depression/suicidality, substance use, and victimization.

^b The global indirect effect, including the combined effects of depression/suicidality, substance use, and victimization.

items, 3 of which focused on suicidality. Therefore, given the weight of suicidality in its calculation, this variable may more accurately reflect severe levels of depressive symptoms. Further, some researchers⁴⁰ have argued that the manner in which AAS misuse is assessed in surveys, such as the YRBS, is biased in overreporting misuse. Specifically, Kanayama et al⁴⁰ argue that because the wording of the item does not explicitly state AAS, but rather “steroids,” participants may erroneously respond to this item thinking about corticosteroids, or over-the-counter sports supplements. On the other hand, Blashill²⁸ contends that these concerns may be minimized in that the steroid item from the YRBS immediately follows other items assessing illicit substances, and thus, participants may respond to the steroid item within the context of thinking about illicit “steroids.” We also statistically controlled for history of asthma, with aims of reducing the bias in responses to lifetime AAS misuse that may have been influenced by interpreting the item to include glucocorticoids. However, because of the possible ambiguity of the item, the prevalence rates may be inflated. At the same time though, there is no conceptual or scientific evidence to suggest that this inflated prevalence rate would vary as a function of sexual orientation and therefore does not account for the large health disparity found in the current study. Additional limitations include the variability in how sexual minority status was assessed across the different jurisdictions in the pooled YRBS. Finally, future research may benefit from examining within-group

differences among sexual minority boys with regard to AAS misuse.

The results from the current study may also inform prevention and intervention efforts. Given the dramatic disparity in the prevalence of AAS misuse among sexual minority boys, it would seem that this is a population in which greater attention is needed. To date, there are limited data on AAS prevention efforts aimed at adolescent boys. The most well-known prevention intervention, Adolescents Training and Learning to Avoid Steroids,⁴¹ was conducted among high school football players, and consisted of 7 weekly, 50-minute class sessions, focusing on the consequences of AAS, healthy alternatives to AAS, role play of drug refusal, and anti-AAS media messages. The program increased healthy behaviors and reduced intent to use AAS, and these effects were sustained over a 1-year period. Prevention efforts focusing on sexual minority adolescent boys may borrow from some of these techniques, but may also benefit from addressing the unique challenges that gay and bisexual adolescents face, namely sexual minority stress. Further, although preliminary, the data from the current study also suggest that addressing depressive symptoms/suicidality, substance use, and victimization may alter the pathway of sexual minority status to AAS misuse. Body image variables were not included in this study; however, Kanayama et al⁴² recommend integrating treatment of body image disturbance with treatment of AAS misuse.

CONCLUSIONS

Sexual minority boys reported a lifetime prevalence of AAS misuse at 21%,

compared with 4% for heterosexual boys. Depressive symptoms/suicidality, victimization, and substance use may account for significant variance in the relationship between sexual minority status and AAS misuse. Prevention and intervention efforts would benefit from focusing on this highly at-risk group.

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