

# Steroid Use, Health Risk Behaviors and Adverse Health Indicators among U.S. High School Students

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#### Abstract

**Background:** Despite recent national attention focusing on steroid use, few studies have assessed the association between steroid use and adverse health indicators among both male and female adolescents. The primary aim is to assess the prevalence of lifetime steroid use and to examine associations between steroid use and health risk behaviors and adverse health indicators among U.S. high school students.

**Methods:** A cross-sectional study examined associations between history of steroid use and aggressive behavior, substance use, mental health status and HIV/STI-associated sexual risk behaviors among a nationally representative sample of 15,425 male and female U.S. high-school students.

**Results:** Overall, 3.5% of adolescents reported a history of steroid use. Males were more likely to report steroid use than females (4.1% vs. 2.9%, p=0.005). Steroid use was associated with team sports participation among males (31.1% non-users vs. 36.2% users, p=0.04) but not among females (49.0% users vs. 47.3% non-users, p=0.71). Males also were more likely than females to report using steroids ≥10 times (49.4% vs. 31.3%, p=0.001). Relative to non-steroid users, both male and female steroid users were significantly more likely to self-report aggression, victimization, sexual behaviors, other substance use and poor mental health. Among males, marked differences were observed with respect to frequency of steroid use and health risk behaviors and adverse health indicators.

**Conclusions:** Steroid use is a risk behavior that may co-occur with other adverse health behaviors, varies by gender, and may be a marker for identifying a diverse array of health risk behaviors and adverse health indicators among adolescents. Screening and recognition of factors associated with steroid use may be beneficial to help address and curb use among adolescents.

Keywords: Adolescents; Steroids; Risk behaviors; Adverse Health Indicators

Abbreviations: YRBS: Youth Risk Behavior Survey

# Introduction

Although recent media attention has markedly increased public awareness of steroid use, misuse of steroids among adolescents has been a public health problem for nearly three decades [1,2]. Steroid use among adolescents is associated with adverse outcomes, including muscle dysmorphia, cardiac and cardiovascular complications, endocrine and neuropsychological dysfunction, as well as immunological and hematological difficulties [3-8]. The economic value of steroids purchased on the black market is substantial, with estimates ranging from 100 to 400 million dollars annually [9]. While declines in the prevalence of adolescent steroid use were observed in the early 2000s, [10] recreational use remains a public health and clinical concern, as illicit use often occurs as high as 10 to 100 times the therapeutic dose prescribed for medical conditions [4,11]. In recognizing this longstanding public health problem, the Healthy People 2020 initiative (Objective SA-18) has prioritized the decrease of steroid use among adolescents, targeting a reduction in prevalence by 10% [12].

Adolescents' illicit use of steroids has been associated with other health risk factors, including needle sharing and HIV [13], lack of condom use [14], not wearing a seatbelt [4,14,15], carrying a weapon [8,14-16], and suicide attempts [4,8,14,16] Adolescents' steroid use often co-occurs with other substance use, including injection drug use[17], alcohol, cocaine, and marijuana [18], Decreased academic performance has also been associated with steroid use [15,17]. While athletes, predominantly males, have been the primary focus of investigation among adolescent steroid users [6,19,20] relatively few national studies have assessed the prevalence of steroid use and the frequency of steroid use and its association with adverse health indicators among both male and female adolescents.

Prior studies among adolescents have typically examined the association between history of steroid use and a single risk behavior [21]. Though valuable, this approach may markedly underestimate the range, magnitude and consistency of adverse effects on health behaviors by not fully capturing the association between steroid use and multiple health behaviors that may cluster into a "syndrome" of problem behaviors [22,23]. Assessment of steroid use in conjunction with a diverse array of health behaviors and adverse health indicators may provide a more complete picture of the co-occurring risks associated with steroid use. The objective of this study was to assess the prevalence of lifetime steroid use and examine the association between steroid use and other health risk behaviors and adverse health indicators among U.S. 9th-12th grade students.

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Received: June 25, 2014; Accepted August 11, 2014; Published August 13, 2014

**Citation:** DiClemente RJ, Jackson JM, Hertzberg V, Seth P (2014) Steroid Use, Health Risk Behaviors and Adverse Health Indicators among U.S. High School Students. Fam Med Med Sci Res 3: 127. doi: 10.4172/2327-4972.1000127

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## Methods

# **Procedures and instrument**

Data for this study were obtained from the 2011 High School Youth Risk Behavior Survey (YRBS). YRBS, established in 1991 and implemented biennially, was designed to monitor priority health risk behaviors among youths [24]. Details of the YRBS sample design and survey methodology have been described previously [24]. Each national survey uses a three-stage, cluster sample design to obtain a nationally representative sample of US high school students.

Participation in the survey was anonymous and voluntary, and local parental permission procedures were used. The most recent survey was conducted in 2011. Students completed a self-administered, computer-scannable 97-item questionnaire in the classroom during normal school hours and under the supervision of trained research professionals. In2011, the total sample size was 15,425 students. For schools administering the survey, the overall student response rate was 87%.

The primary predictor variable, adolescents' steroid use, was assessed with a single item "During your life, how many times have you taken steroid pills or shots without a doctor's prescription?" Respondents who endorsed "any steroid use" were categorized as "users". Adolescents also reported frequency of steroid use. Response options ranged from 0 times, 1-2 times, 3-9 times, 10-19 times, 20-39 times and 40 times or more. Adolescents' steroid use was categorized to create a three-level ordinal measure of frequency of steroid use based on their distribution of responses; non-users, used steroids 1-9 times or used steroids  $\geq 10$  times. Additionally, the outcomes included several health indicators from the YRBS, which were clustered conceptually within five categories: aggression, victimization, substance use, mental health, and sexual health. Similar to steroid use, frequency of each health indicator was dichotomized into "yes" or "no." The Institutional Review Board at the Centers for Disease Control and Prevention approved the national YRBS.

#### Data analysis

Analyses were performed on weighted data to account for the complex sampling design using SAS 9.3 (SAS/GRAPH 9.3, SAS Institute, Inc.). Adolescents who omitted indicating a grade level (n=27) were excluded. Contingency table analyses compared sociodemographic and other descriptive characteristics among adolescents who did and did not report a history of steroid use. Summary statistics described the lifetime frequency of steroid use for males and females separately. Unadjusted and adjusted logistic regression models were computed examining adolescents' history and frequency of steroid use and the likelihood of other health risk behaviors and adverse health indicators. Given the limited data available for females, analyses were conducted separately for males and females. Adjusted models controlled for racial/ethnic differences and non-response among steroid and non-steroid users.

## Results

Overall, 3.5% (95% CI: 3.1, 4.0) of the sample reported a history of steroid use. Prevalence was highest among males [4.1% among males (95% CI: 3.6, 4.7)] versus 2.9% among females (95% CI: 2.2, 3.5%)].

Relative to females, a greater proportion of males were high frequency users, defined as using steroids  $\geq 10$  times (49.4% vs. 31.3%, p=0.001) (Figure 1 for the distribution of steroid use by gender). Table 1 presents demographic and other characteristics by adolescents' history of steroid use. Overall, no differences in age, grade, race/ethnicity



or participation in team sports were observed between users and non-users. Subsequent analyses were stratified by gender to identify patterns of associations that might be masked when examining males and females together. Relative to male non-users, greater proportions of male steroid users were categorized as Multiple-non-Hispanic (14.6% vs. 10.4%) and other (11.9% vs. 8.8%). Additionally, a greater proportion of male steroid users reported participating in team sports (36.2% vs. 31.1%, p=.04).

Relative to female non-users, greater proportions of female users were categorized as Multiple-non-Hispanic (14.1% vs. 11.0%) and Multiple-Hispanic (14.9% vs. 8.9%). No difference in team sports participation was observed among females (49.0% users vs. 47.3% non-users, p=0.71).

Table 2 presents unadjusted and adjusted associations between steroid use and high-risk behaviors and Tables 3 and 4 present similar analyses stratified by gender. In the unadjusted and adjusted analyses (Table 2), steroid users among the overall sample were significantly more likely than non-users to endorse each of the aggression, victimization, substance use and mental health measures examined. Of the 30 outcomes assessed, significant differences between steroid users and non-users were observed for 29 outcomes among the overall sample.

Tables 3 and 4 present unadjusted and adjusted associations between steroid use and health indicators as well as frequency of steroid use and high-risk behaviors among males and females, respectively. In general, males and females reporting using steroids 1-9 and  $\geq$ 10 times were more likely than non-users to endorse high-risk behaviors. However, being bullied at school was not statistically different among females reporting using steroids 1-9 times (AOR: 1.6, 95% CI: 0.9, 2.8) and marginally statistically significant among females reporting using steroids  $\geq$ 10 times (AOR: 1.8, 95% CI: 1.0, 3.4). Additionally, being electronically bullied was not statistically significant among females reporting using steroids  $\geq$ 10 times (AOR: 1.9, 95% CI: 1.0, 3.5). Condom use at last sex was only significant in adjusted analyses for males using steroids 1-9 times (AOR: 1.7, 95% CI: 1.1, 2.7).

In both unadjusted and adjusted analyses, frequency of steroid use among males and females was associated with health risk behaviors. Citation: DiClemente RJ, Jackson JM, Hertzberg V, Seth P (2014) Steroid Use, Health Risk Behaviors and Adverse Health Indicators among U.S. High School Students. Fam Med Med Sci Res 3: 127. doi: 10.4172/2327-4972.1000127

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Characteristic	A 11	All Respondents			Males			Females		
	All	Non-users	Users	р	Non-users	Users	р	Non-users	Users	р
Age (years)										
≤14	11.6	11.8	13.4	0.77	10.8	13.1	0.43	12.8	13.6	0.40
15	24.8	24.6	26.8		24.6	24.3		24.5	30.9	
16	26.1	26.2	23.4	0.77	26.3	23.2		26.2	23.2	
17	23.9	24.0	23.1		23.9	26.5		24.3	18.2	
≥18	13.3	13.4	13.3		14.4	12.9		12.3	12.1	
Grade										
9 <sup>th</sup>	27.7	27.4	33.1	0.09	27.4	30.2	0.69	27.5	37.4	0.11
10 <sup>th</sup>	25.8	25.7	23.1		26.1	25.4		25.3	19.6	
11 <sup>th</sup>	23.9	23.9	25.5		23.8	24.0		24.1	27.9	
12 <sup>th</sup>	22.6	23.0	18.3		22.7	20.4		23.2	15.1	
Sex										
Male	51.6	51.1	60.3	0.005						
Female	48.4	48.9	39.7							
Race/ ethnicity										
White	56.9	57.4	55.2		57.9	53.6	0.000	56.9	57.6	0.010
Black	14.1	13.8	11.5		13.3	14.7		14.3	6.5	
Multiple-Hispanic	9.2	9.3	9.0	0.12	9.7	5.2 0.002	8.9	14.9	0.016	
Multiple-Non-Hispanic	10.8	10.7	14.4		10.4	14.6		11.0	14.1	
Other	9.0	8.9	9.9		8.8	11.9		9.0	6.9	
Participation in team sports										
Yes	41.6	58.3	61.8	0.00	36.2	31.1	0.04	47.3	49.0	0.71
No	58.4	41.7	38.2	0.22	63.8	68.9		52.7	51.0	

Data are weighted percentages

Table 1: Sociodemographic and other descriptive characteristics among US 9th-12th grade students, by history of steroid use, for all respondents, males and females.

	All Users				
Health Indicator	OR (95% CI)	AOR <sup>†</sup> (95% CI)	p <sup>∆</sup>		
Aggression					
Carried a weapon, past 30 days	6.0 (4.6, 7.8)	5.9 (4.5, 7.6)	<.0001		
Carried a gun, past 30 days	10.8 (8.3, 14.0)	10.6 (8.2, 13.6)	<.0001		
Carried a weapon on school property, past 30 days	11.4 (8.6, 15.0)	11.4 (8.6, 15.2)	<.0001		
In a physical fight, past 12 months	6.6 (5.2, 8.4)	6.7 (5.2, 8.5)	<.0001		
In physical fight on school property, past 12 months	6.9 (5.5, 8.6)	7.0 (5.6, 8.8)	<.0001		
Victimization					
Did not go to school at least 1 day in past 30 days because felt unsafe	7.4 (5.5, 9.9)	7.4 (5.5, 9.9)	<.0001		
Threatened or injured with weapon on school property, past 12 months	8.2 (6.2, 10.9)	8.2 (6.3, 10.9)	<.0001		
Bullied on school property, past 12 months	1.8 (1.4, 2.5)	1.8 (1.3, 2.5)	.0001		
Electronically bullied, past 12 months	2.8 (2.1, 3.6)	2.8 (2.1, 3.7)	<.0001		
Physically hurt by boyfriend or girlfriend, past 12 months	6.1 (5.1, 7.5)	6.2 (5.1, 7.5)	<.0001		
History of forced sex	5.8 (4.4, 7.5)	5.7 (4.4, 7.4)	<.0001		
Substance use			- -		
History of smoking cigarettes	8.0 (5.8, 11.1)	7.9 (5.6, 11.3)	<.0001		
Smoked cigarettes, past 30 days	7.3 (5.6, 9.6)	7.2 (5.4, 9.6)	<.0001		
History of alcohol use	10.0 (5.7, 17.3)	10.4 (5.9, 18.3)	<.0001		
Used alcohol, past 30 days	7.5 (5.3, 10.6)	7.9 (5.6, 11.3)	<.0001		
Drank 5 or more drinks within a couple of hours, past 30 days	6.5 (5.0, 8.5)	6.6 (5.0, 8.8)	<.0001		
History of marijuana use	8.6 (5.8, 12.8)	9.1 (6.0, 13.9)	<.0001		
Used marijuana, past 30 days	6.8 (4.9, 9.4)	6.9 (4.9, 9.7)	<.0001		
History of cocaine use	16.7 (12.5, 22.3)	16.7 (12.2, 22.9)	<.0001		
Used cocaine, past 30 days	30.1 (22.0, 41.2)	29.7 (21.6, 40.7)	<.0001		
Mental Health, past 12 months					
Felt so sad or hopeless almost every day for ≥2 weeks in a row that stopped doing some usual activities	3.2 (2.6, 3.9)	3.2 (2.6, 3.9)	<.0001		
Considered suicide	3.6 (2.8, 4.7)	3.6 (2.7, 4.6)	<.0001		
Made a suicide plan	4.3 (3.5, 5.3)	4.2 (3.4, 5.3)	<.0001		
Attempted suicide	8.3 (6.4, 10.8)	8.4 (6.4, 11.0)	<.0001		
Suicide attempt resulted in treatment	14.2 (9.7, 20.8)	14.2 (9.7, 20.8)	<.0001		
Sexual Health					
Sexually experienced	6.0 (4.3, 8.4)	6.3 (4.4, 8.9)	<.0001		
Had sex, past 3 months	6.6 (4.9, 8.8)	6.9 (5.1, 9.4)	<.0001		
≥4 lifetime sexual partners	6.4 (4.9, 8.3)	6.7 (5.3, 9.1)	<.0001		
Used drugs or alcohol before last sex	6.1 (4.4, 8.5)	6.3 (4.5, 9.0)	<.0001		
Used a condom at last sex	1.3 (0.9, 1.7)	1.3 (1.0, 1.8)	0.09		

Reference group: non-users; †Adjusted for race/ethnicity; <sup>A</sup>Significance level for AOR

Table 2: Unadjusted and adjusted associations between steroid use and health risk behaviors among US 9<sup>th</sup>-12<sup>th</sup> grade students, overall.

	Steroid Use							
		Males		Females				
Health Indicator	OR (95% Cl)	AOR <sup>†</sup> (95% CI)	p^	OR (95% CI)	AOR† (95% CI)	p^		
Aggression								
Carried a weapon, past 30 days	5.5 (4.1, 7.4)	5.4 (4.0, 7.3)	<.0001	8.2 (5.4, 12.5)	8.4 (5.4, 13.1)	<.0001		
Carried a gun, past 30 days	10.3 (7.6, 13.8)	9.8 (7.4, 13.0)	<.0001	16.5 (9.2, 29.5)	19.6 (10.8, 35.3)	<.0001		
Carried a weapon on school property, past 30 days	9.9 (7.5, 13.1)	10.2 (7.6, 13.7)	<.0001	16.1 (9.8, 26.5)	16.7 (10.0, 27.9)	<.0001		
In a physical fight, past 12 months	6.8 (4.7, 9.7)	6.7 (4.7, 9.6)	<.0001	6.3 (4.5, 8.8)	6.6 (4.5, 9.7)	<.0001		
In physical fight on school property, past 12 months	7.0 (5.4, 9.2)	7.0 (5.3, 9.3)	<.0001	6.2 (4.2, 9.0)	6.9 (4.7, 10.3)	<.0001		
Victimization				· · · · ·				
Did not go to school at least 1 day in past 30 days because felt unsafe	9.3 (6.2, 14.1)	9.3 (6.2, 13.9)	<.0001	5.3 (3.4, 8.3)	5.2 (3.3, 8.3)	<.0001		
Threatened or injured with weapon on school property, past 12 months	9.3 (6.9, 12.5)	9.1 (6.8, 12.2)	<.0001	6.0 (3.6, 9.9)	6.4 (3.8, 10.6)	<.0001		
Bullied on school property, past 12 months	2.1 (1.3, 3.2)	2.0 (1.3, 3.2)	0.002	1.7 (1.1, 2.5)	1.7 (1.1, 2.4)	0.008		
Electronically bullied, past 12 months	3.8 (2.6, 5.5)	3.8 (2.6, 5.5)	<.0001	2.4 (1.6, 3.6)	2.5 (4.6, 3.8)	<.0001		
Physically hurt by boyfriend or girlfriend, past 12 months	7.3 (5.9, 9.0)	7.0 (5.5, 8.8)	<.0001	4.8 (3.5, 6.6)	5.1 (3.7,7.0)	<.0001		
History of forced sex	12.3 (8.6, 17.5)	11.7 (8.0, 17.0)	<.0001	3.8 (2.7, 5.3)	4.0 (2.9, 5.6)	<.0001		
Substance use								
History of smoking cigarettes	9.2 (5.6, 14.9)	8.9 (5.4, 14.6)	<.0001	6.7 (4.5, 10.2)	6.9 (4.4, 10.9)	<.0001		
Smoked cigarettes, past 30 days	7.4 (4.9, 11.2)	7.3 (4.9, 11.1)	<.0001	7.0 (4.8, 10.1)	6.8 (4.5, 10.0)	<.0001		
History of alcohol use	10.5 (5.3, 20.9)	10.6 (5.2, 21.3)	<.0001	9.4 (3.4, 25.7)	10.8 (3.4, 35.0)	<.0001		
Used alcohol, past 30 days	8.6 (5.2, 14.1)	9.3 (5.6, 15.5)	<.0001	6.3 (3.8, 10.4)	6.5 (3.9, 11.0)	<.0001		
Drank 5 or more drinks within a couple of hours, past 30 days	6.3 (4.3, 9.5)	6.7 (4.5, 10.0)	<.0001	6.6 (4.7, 9.3)	6.4 (4.5, 9.2)	<.0001		
History of marijuana use	9.5 (5.8, 15.7)	10.5 (6.1, 17.8)	<.0001	7.6 (4.1, 14.0)	7.9 (4.1, 15.2)	<.0001		
Used marijuana, past 30 days	7.4 (5.2, 10.5)	7.7 (5.2, 11.2)	<.0001	6.0 (3.5, 10.5)	6.2 (3.5, 10.8)	<.0001		
History of cocaine use	20.9 (15.2, 28.8)	22.7 (15.9, 32.2)	<.0001	11.2 (6.7, 18.7)	10.2 (5.9, 17.5)	<.0001		
Used cocaine, past 30 days	32.1 (22.4, 45.9)	34.8 (23.7, 51.2)	<.0001	24.7 (14.8, 41.2)	22.5 (13.3, 8.0)	<.0001		
Mental Health, past 12 months								
Felt so sad or hopeless almost every day for ≥2 weeks in a row that stopped doing some usual activities	3.7 (2.8, 4.8)	3.7 (2.8, 4.6)	<.0001	3.4 (2.3, 5.1)	3.3 (2.2, 4.9)	<.0001		
Considered suicide	4.2 (3.1, 5.7)	4.2 (3.1, 5.7)	<.0001	3.5 (2.2, 5.6)	3.4 (2.1, 5.5)	<.0001		
Made a suicide plan	5.0 (3.7, 6.7)	5.0 (3.7, 6.9)	<.0001	4.0 (2.8, 5.6)	3.8 (2.7, 5.5)	<.0001		
Attempted suicide	12.2 (8.8, 16.9)	12.3 (8.6, 17.4)	<.0001	6.6 (4.1, 10.5)	6.7 (4.2, 10.7)	<.0001		
Suicide attempt resulted in treatment	26.1 (15.4, 44.2)	25.2 (15.6, 43.8)	<.0001	8.7 (5.5, 13.7)	9.4 (6.0, 14.9)	<.0001		
Sexual Health								
Sexually experienced	9.9 (6.4, 15.3)	10.9 (6.9, 17.2)	<.0001	3.8 (2.2, 6.3)	3.9 (2.3, 6.5)	<.0001		
Had sex, past 3 months	8.8 (6.1, 12.7)	9.6 (6.6, 14.0)	<.0001	4.7 (3.0, 7.4)	4.9 (3.1, 7.7)	<.0001		
≥4 lifetime sexual partners	9.6 (6.8, 13.6)	11.1 (7.9, 15.6)	<.0001	3.5 (2.4, 5.3)	4.0 (2.7 (6.1)	<.0001		
Used drugs or alcohol before last sex	10.0 (6.4, 15.4)	11.0 (6.9, 17.4)	<.0001	3.8 (2.3, 6.4)	3.9 (2.3, 6.6)	<.0001		
Used a condom at last sex	0.3 (0.2, 0.5)	0.3 (0.2, 0.5)	0.09	0.4 (0.2, 0.7)	0.4 (0.2, 0.7)	0.69		

Reference group: non-users; <sup>†</sup>Adjusted for race/ethnicity; <sup>Δ</sup>Significance level for AOR

Table 3: Unadjusted and adjusted associations between steroid use and health risk behaviors and adverse health outcomes.

Furthermore, we observed within-gender differences by frequency of use.

Given that the 95% confidence intervals around the estimates did not overlap, males who reported using steroids  $\geq$ 10 times were markedly more likely than males using steroids 1-9 times to endorse recently carrying a weapon (AOR: 17.0, 95% CI: 12.2, 23.5), recently carrying a weapon to school (AOR: 16.9, 95% CI: 11.5, 25.0), history of cocaine use (AOR: 53.8, 95% CI: 29.8, 97.1), recent cocaine use (AOR: 69.2, 95% CI: 39.7, 120.5) and  $\geq$ 4 lifetime sexual partners (AOR: 30.4, 95% CI: 16.4, 56.4). In adjusted analyses among females, those reporting using steroids  $\geq$ 10 times were also more likely to report  $\geq$ 4 lifetime sexual partners (AOR: 30.4, 95% CI: 16.4, 56.4). There were no statistically significant between-gender or within-gender differences by frequency of steroid use in adjusted analyses for condom use at last sex.

# Discussion

This is one of a few studies to examine associations between nonmedically prescribed lifetime steroid use and lifetime frequency of steroid use with multiple high-risk behaviors and health indicators among a nationally representative sample of U.S. high school students. The overall lifetime prevalence of non-medically prescribed steroid use was 3.5%, which is similar to previous estimates [17,25] Consistent with other studies [17-19,23,25,26] a greater proportion of males reported steroid use and were more likely to report more frequent use ( $\geq$ 10 times). Although steroid use is less prevalent, especially in comparison to more commonly used drugs such as alcohol and marijuana,17 the findings suggest that steroid use is associated with multiple health risk behaviors and adverse health indicators, including aggressive behaviors, victimization, substance use, mental health issues and sexual risk behavior, among both males and females. Furthermore, among males, higher frequency of steroid use was associated with increased risk for some health risk behaviors and adverse health indicators.

Aggression is widely recognized as being associated with steroid use [3,26-28]. This study found markedly elevated risk of aggressive behaviors among both male and female steroid users relative to non-

<.0001 <.0001 <.0001 <.0001 <.0001 <.0001 0.038 0.05 <.0001 <.0001 0.0001 <.0001 0.04 0.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 .. ď 18.6 (10.4, 33.2) 11.0 (5.5, 22.1) 5.9 (3.1, 11.3) 24.1 (4.9, 117.6) 22.0 (11.1, 43.2) 86.5) 152.3) 38.5 (9.6, 153.7) 22.1) 19.8) 11.3 (6.9, 18.2) 25.3) 29.4) 36.7) 56.4) AOR<sup>+</sup> (95% CI) 16.1) 12.7) 43.4) 9.0 (2.9, 28.0) 20.3) 9.2 (5.8, 14.6) 15.8) 9.9 (5.1, 18.3) 6.7 (4.0, 11.3) 72. 1.8 (1.0, 3.4) 3.5) 5.1 (2.8, 9.3) 6.7) 5.2 (2.8, 9.6) 3.5) more times 31.6 (13.9, 1.9 (1.0, 16.6 (7.5, 44.0 (22.4, 30.4 (16.4, 11.7 (5.4, 6.8 (3.6, 6.2 (2.5, 6.7 (1.0, 7.7 (3.7, 11.2 (6.3, 15.5 (8.2, 9.8 (4.7, 4.02.4, 38.3 (9.6, 1.8 (0.9, ъ 20.4) 43.7) 152.9) 65.5) 23.7 (4.8, 116.8) 24.7 (12.6, 8.5) 38.7 (9.9, 151.2) 20.8) 10.6 (5.4, 20.8) 5.5 (3.0, 10.4) 11.1 (6.9, 18.0) 27.2) 15.9) 9.1 (2.9, 28.3) 10.1 (4.9, 20.5) , 31.6) 15.9 (7.3, 34.1) 17.4 (9.5, 32.0) 10.0 (5.4, 18.3) 7.0 (1.1, 46.1) 7.4 (3.5, 15.7) 49.8 (25.1, 8.8) 9 (95% CI) 7.0 (3.8, 13.3) 6.8 (4.1, 11.4) 8.9 (5.6, 14.3) 5.1 (2.8, 9.3) 5.3 (2.9, 9.8) 1.9 (1.0, 3.4) 1.9 (1.0, 3.6) 4.1 (2.5, 6.9) 1.7 (0.9, 3.2) 11.73 (6.2, 28.9 (12.7, 6.3 (2.5, 24.6 (13.8, 15.4 (7.5, 12.6 (5.8, 38.8 (9.8, В Females <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 0.0033 0.0022 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 0.138 <.0001 <.0001 0.0003 0.0001 <.0001 <.0001 0.0003 0.002 9.0 ₫ 32.9) เ 15.8 (7.9, 31.4) 28.3) 12.1) 5.7 (2.8, 11.7) Table 4: Unadjusted and adjusted associations between frequency of steroid use and health risk behaviors 15.7 (5.4, 45.3) 6.5 (3.6, 11.6) 7.2 (4.1, 12.6) 8.0) 3.5 (2.1, 5.7) 7.4 (4.8, 11.3) 5.6 (2.7, 11.7) 5.6 (3.1, 10.1) 9.7) 13.4) 10.9) 6.2 (3.4, 11.1) 5.7 (3.5, 9.2) 6.5 (4.0, 10.8) 4.4 (2.6, 7.5) 4.4) 5.2 (3.0, 8.9) 5.5) 6.9) 3.5 (2.0, 6.0) 2.7 (1.4, 5.2) 2.8) 4.7) 8.5) 0.8(0.4, 1.7) AOR<sup>†</sup> (95% 4.1 (2.4, 1.6 (0.9, 13.8 (5.8, 5.2 (3.4, 7.5 (4.7, 2.8 (1.6, 2.9 (1.9, 13.6 (6.5, 3.0 (1.6, 4.9 (2.5, 5.4 (3.4, 6.5 (3.2, 6.4(3.4, I-9 times 25.8) 15.8 (8.0, 30.9) 15.4 (8.1, 29.3) 6.5 (4.2, 10.1) 7.1 (4.2, 11.9) 11.2 (4.2, 29.6) 5.4 (2.7, 10.8) 5.5 (2.8, 10.9) 7.3 (4.3, 12.4) 11.4) 7.0(4.7, 10.4) 9.3) 9.2) (95% CI) 2.7 (1.9, 4.1) 3.3 (2.0, 5.3) 5.9 (3.7, 9.3) 5.5 (3.1, 9.9) 7.3) 4.5 (2.7, 7.5) 3.8 (2.2, 6.5) 5.4 (3.1, 9.3) 1.6 (0.9, 2.9) 3.3 (2.0, 5.5) 5.3 (3.2, 8.9) 3.1 (1.7, 5.5) 2.7(1.5, 5.3) 4.8) 9.2) 7.3) 0.5 (0.3, 0.8) 3.0 (1.8, 4 5.7 (3.6, 5.0 (3.4, 4.8 (2.5, 5.3 (3.1, (5.0, 4.7 (3.0, 5.8 (2.9, 11.3 ( RO <.0001 <.0001<br/><.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 0.002 <.0001 0.69 ۵ 12.6 (6.0, 26.2) 12.4 (6.7, 21.9) 53.8 (29.8, 97.1) 29.0) 63.7) 69.2 (39.7, 120.5) 2 16.9 (11.5, 25.0) 6.5 (3.7, 11.3) 7.7 (5.3, 11.0) 38.5 (9.6, 153.7) 18.3 (11.3, 29.8) 38.3 (9.6, 152.3) 30.4 (16.4, 56.4) 10.1 (5.9, 17.3) 11.1) 11.7 (3.5, 38.5) 16.6 (7.5, 36.7) AOR<sup>+</sup> (95% CI) 7.5 (4.8, 11.5) 11.7 (8.1, 16.9) 9.2 (5.2, 16.3) 11.4 (5.4, 24.0) 9.7 (5.2, 18.1) 4.5 (2.7, 7.6) 9.5 (6.4, 12.3) 5.3 (3.4, 8.3) 6.2 (4.2, 9.1) 2.1 (1.3, 3.4) 3.6 (2.3, 5.5) 23. 1.1 (0.6, 2.0) more times 17.0 (12.2, 17.6 (10.7, 34.2 (18.4, 5.9 (3.2, 10 or r 47.0 (27.0, 82.0) 63.0 (37.2, 06.6) 6 16.3 (11.4, 23.1) 10.9 (5.7, 20.9) 11.1 (6.4, 19.3) 25.8) 27.6) 64.5) 38.7 (9.9, 151.2) 24.6 (13.8, 43.7) 38.8 (9.8, 152.9) 6.8 (4.0, 11.6) 7.7 (5.6, 10.7) 20.2 (12.7, 32.3) 10.6 (6.2, 18.0) 12.1 (8.3, 17.6) 37.7) 15.9 (7.3, 34.1) 9.8 (4.9, 19.5) ີວ 7.6 (4.9, 11.7) 10.3 (7.1, 14.8) 6.2 (3.3, 11.4) 9.2 (5.3, 15.8) 8.6 (4.8, 15.4) 7.3) 5.5) 8.3) 9.0) 2.0 (1.3, 3.3) 1.1 (1.0, 2.3) 34.9 (18.8, OR (95% 18.0 (12.6, 17.3 (10.9, 5.3 (3.3, 4.4 (2.7, 11.6 (3.6, 3.6 (2.3, 6.1 (4.1, Males 0.012 ₽

Reference group: non-users, <sup>†</sup>Adjusted for race/ethnicity; <sup>A</sup>Significance level for AOR; Bolded estimates are not statistically significant at p<0.05

<.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 <.0001 0.009 <.0001 10.7 (6.5, 17.6) ີວົ 11.7) 8.5 (5.3, 13.7) 10.9) 6.7 (3.7, 12.1) 15.9 (8.4, 30.1) 8.8 (4.4, 17.6) 29.7) 8.1 (4.8, 13.7) 43.4) 10.9) 6.5 (4.1, 10.2) 9.6 (4.2, 22.0) 7.7 (4.0, 14.8) 6.2 (3.4, 11.1) 6.5 (4.0, 10.8) 5.8 (3.6, 9.2) 5.4) 5.7) 7.6) 6.0 (3.9, 9.2) 3.4) 5.0) 5.0 (3.1, 7.9) 4.7 (2.9, 7.7) 5.2 (3.1, 8.8) 5.5) 6.5) 5.4 (3.4, 8.5) 1.7 (1.1, 2.7) AOR<sup>+</sup> (95% 5.1 (3.4, 7 3.2 (2.0, ! 3.3 (2.0, 4.0 (2.5, 4.0 (2.8, 2.0 (1.2, 16.4 (9.0, 3.8 (2.6, 17.8 (7.3, 6.9(4.1, 7.0 (4.5, 6.4 (3.4, -9 times 5.2 (3.2, 8.6) 10.2 (6.5, 15.9) 15.1 (9.1, 25.3) 13.3) 43.0) 8.1 (5.1, 13.1) 16.2 (8.8, 30.1) 11.2) 7.1 (4.6, 11.1) 7.6 (3.9, 14.7) 8.4 (4.2, 16.8) 6.6 (3.9, 11.3) 5.9 (3.7, 9.4) 9.6 (4.2, 21.7) 6.4 (4.2, 9.9) 5.1) 4.8 (3.0, 7.7) 3.3 (2.0, 5.4) 1.5 (0.7, 1.9) **DR (95% CI)** 5.7) 5.3 (3.6, 7.8) 5.8 (3.9, 8.7) 2.1 (1.2, 3.6) 5.0 (3.2, 7.6) 3.7 (2.6, 5.5) 4.0 (2.5, 6.3) 9.2) 5.7 (3.6, 9.2) 4.7 (3.0, 7.3) 5.4 (3.1, 9.3) 3.3 (2.1, 8.2 (5.1, 5.3 (3.1, 4.0 (2.9, 6.7 (4.0, 18.8 (8.2, Electronically bullied, past 12 onths every day for ≥2 weeks in a row that stopped doing some usual activities Did not go to school at least 1 day in past 30 days because felt unsafe Threatened or injured with weapon In physical fight on school property, on school property, past 12 months Bullied on school property, past 12 12 months last Smoked cigarettes, past 30 days Mental Health, past 12 months past 30 days Drank 5 or more drinks within a Physically hurt by boyfriend or Felt so sad or hopeless almost days Used drugs or alcohol before I couple of hours, past 30 days History of smoking cigarettes Carried a weapon on school cocaine, past 30 days Carried a gun, past 30 days Used alcohol, past 30 days .⊆ ≥4 lifetime sexual partners sex Health Indicator girlfriend, past 12 months Used marijuana, past 30 ( History of marijuana use resulted Had sex, past 3 months In a physical fight, past History of cocaine use Used a condom at last past 30 days History of alcohol use Sexually experienced History of forced sex Made a suicide plar Considered suicide Carried a weapon, Attempted suicide Suicide attempt Substance use past 12 months Sexual Health Victimization Aggression treatment property, months Used sex Fam Med Med Sci Res

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Citation: DiClemente RJ, Jackson JM, Hertzberg V, Seth P (2014) Steroid Use, Health Risk Behaviors and Adverse Health Indicators among U.S.

users. In addition, males reporting more frequent steroid use were more likely than males reporting less frequent use to endorse recently carrying a weapon on school property. Other studies have reported increased levels of aggressive behaviors among steroid users and the increase of aggressive behavior with higher levels of steroid use [3,26-28]; however, this is the first study, to our knowledge, to report these findings separately for males and females and to identify gender as an effect modifier of the relationship between frequency of steroid use and carrying a weapon at school.

The findings show that adolescent steroid users are more likely to endorse a diverse set of victimization measures. Although other studies have reported associations between steroid use and experiencing violence [16,27], we are unaware of other studies reporting associations between steroid use and being bullied and feeling unsafe at school. Further research on the association and pathway between experiencing violence and bullying and steroid use may benefit future prevention efforts [29].

Additionally, both male and female steroid users were more likely to endorse other forms of substance use. A greater frequency of steroid use was associated with increased likelihood of endorsing a history of cocaine use as well as recent cocaine use among males but not females. While other studies have observed associations between steroid use and substance use [13,16,27], the present findings identify gender as a potential effect modifier of the relationship between frequency of steroid use and cocaine use.

Consistent with other studies [26,28,30], elevated depressive symptomatology and measures of suicidality was associated with steroid use. However, the present analyses are unable to determine if mental health status is a determinant of steroid use, associated with ongoing steroid use, discontinuation of use, or an unmeasured cofactor.

Recently, a spate of media coverage has highlighted high-profile athletes from a variety of sports who have been penalized for illicit use of performance enhancing drugs [31-35]. Penalties have included suspensions, fines, loss of corporate sponsorships, and occasionally, athletes have been stripped of Olympic metals and denied other awards [31-35]. However, the repercussions of athletes' use of performance enhancing drugs on adolescents' perceptions of the dangers of steroid use and their intentions to initiate or continue steroid use are unknown. In fact, there may be a paradoxical effect of media exposure. Adolescents may equate steroid use with enhanced performance. Thus, they may construe the extensive media coverage as an indicator that even very skilled and talented world-class athletes perceive a benefit from performance enhancing drugs and are willing to risk significant sanctions. Thus, rather than dissuading adolescents from initiating steroid use, adolescents may perceive that the benefits of steroid use outweigh the potential health risk, sanctions and social opprobrium. Understanding the impact on media coverage of steroid use in professional sports on adolescents' perceptions of steroid-associated health risk may be critical to designing optimally effective media-based intervention programs.

Schools, physicians, parents and structural interventions may be important for preventing steroid use, screening adolescents to identify users, and addressing its potential adverse consequences. Effective steroid use prevention strategies have leveraged the influence of peer leaders and school athletic team coaches to achieve decreases in both intent to use steroids as well as actual steroid use [36,37]. Furthermore, schools, social media campaigns, physicians and parents may be instrumental in increasing adolescents' awareness of the health hazards of steroid use and enhancing their ability to make informed decisions. Physicians should be encouraged to screen adolescents for steroid use, particularly among high-risk adolescent populations and those who may be abusing other substances. Additionally, schools and families should be educated on symptoms of steroid use and potential risk factors among male and female adolescents. Although schools may screen athletes for steroid use, the findings from this study highlight that at least for females, participation in sports was not associated with use. Therefore, additional screening and prevention programming would be valuable for this population.

Despite the existence of national and international policies regulating the non-medical sale, distribution and use of steroids [26,38], access to and use of steroids remains problematic. Little is known about the direct impact of legal restraints and anti-doping sanctions on use of steroids among adolescents. Such policy-level interventions should be further investigated.

## Limitations

These findings should be interpreted in light of the study's limitations. Foremost, given that the data are cross-sectional, this study cannot establish causality. The findings are unable to indicate whether steroid use is a determinant, antecedent, a consequence of other risk behaviors, or co-occurs with many health risk behaviors and adverse health indicators. However, in any case, steroid use may serve as an important marker for adverse health outcomes among adolescents. Second, the survey did not collect data on the chronicity of steroid use, dosing, where steroids were purchased or from whom were they purchased. Third, the findings are based on adolescents' self-report and may be subject to socially desirable responding. In this case, adolescents may under-report their steroid use. Thus, the actual prevalence of steroid use may be greater than that observed in this analysis. Conversely, the findings may be subject to extreme response bias [39]; for example, previous examination of YRBS data has documented "extreme responding," whereby adolescents give extreme responses indiscriminately to both healthy (e.g., exercising everyday) and high-risk behaviors (e.g., carrying a gun six or more times in the past month) [39]. Fourth, although other researchers have dispelled ideas that youth might misinterpret the YRBS question on steroid use to include types of steroids other than anabolic steroids (e.g. corticosteroids) [18,40], the wording of the survey question does not specify the type of steroid use. Lastly, the YRBS is a school-based study, thus the findings may not be generalizable to out-of-school youth.

## Conclusion

This study identified robust and consistent associations across a diverse range of health outcomes. Steroid use for both males and females co-occurs with many health risk behaviors and adverse health indicators and may serve as a marker for high-risk adolescents. Further research regarding adolescents' motivations for steroid use may be important in informing the development of effective media, clinical, school and parental education and prevention programs.

#### Acknowledgment

Jerrold M. Jackson was supported by National Institute of General Medical Sciences grant number K12 GM000680.

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Citation: DiClemente RJ, Jackson JM, Hertzberg V, Seth P (2014) Steroid Use, Health Risk Behaviors and Adverse Health Indicators among U.S. High School Students. Fam Med Med Sci Res 3: 127. doi: 10.4172/2327-4972.1000127

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