

Original article

The Effect of High School Sports Participation on the Use of Performance-Enhancing Substances in Young Adulthood

Tonya L. Dodge, Ph.D.^{a,*} and James J. Jaccard, Ph.D.^b

^aDepartment of Psychology, The George Washington University, Washington, DC

^bFlorida International University, Miami, Florida

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Abstract

Purpose: The present study examined the relationship between high school sports participation and the use of anabolic steroids (AS) and legal performance-enhancing dietary supplements in young adulthood. Additionally, the relationship between the use of AS and legal dietary supplements was explored.

Methods: Data on approximately 15,000 adolescents from the National Longitudinal Study of Adolescent Health were used. School sports participation was assessed when adolescents were in grades 7–12. AS use and legal performance-enhancing dietary supplement use were assessed six years later.

Results: Males were more likely than females to use AS and legal supplements. A sport by gender interaction emerged for the use of AS, indicating that the gender differences in AS use were greater for those who participated in sports during high school. High school sports participation was associated with increased likelihood that adolescents would use legal supplements in young adulthood. Finally, there was a positive relationship between the use of legal dietary supplements and AS use.

Conclusions: This study highlights the important role that the social environment during adolescence has on future health behaviors. Results suggest that the sporting context experienced during early adolescence may have lasting effects on the use of performance-enhancing substances. The use of legal performance-enhancing dietary supplements appears to be more prevalent than the use of AS, and there seems to be a positive relationship between the use of AS and legal performance-enhancing dietary supplements. © 2006 Society for Adolescent Medicine. All rights reserved.

Keywords:

Steroids; Performance-enhancing substances; Dietary supplements; Sports; Adolescent

Performance-enhancing substances (PES) are substances used by adolescents to help improve physical/athletic performance or physical appearance. The most frequently studied PES are anabolic steroids (AS). AS are used primarily by males, with prevalence estimates ranging from 4% to 6% [1–3]. Estimates for females range from .2 to 2.9% [4–7]. Individuals who use AS illegally (i.e., without a doctor's prescription) are at increased risk for health problems including heart disease, reproductive problems and even pre-

mature death [7–9]. Those who use AS are also more likely than non-users to experience aggression, depression, and mood disturbance [4,10,11].

In addition to illegal AS, there is an abundance of legal dietary supplements available that claim to improve athletic/physical performance. Some of the supplements available replenish nutrients lost during exercise and are relatively safe (e.g., creatine), whereas others mimic the effects of AS (e.g., Dehydroepiandrosterone) and may have side effects similar to those associated with AS use. The present study documents the prevalence of PES, factors associated with the use of such substances, and whether there is a relationship between the use of legal dietary supplements and AS.

*Address correspondence to: Dr. Tonya L. Dodge, Department of Psychology, The George Washington University, 2125 G Street, Washington, DC 20052.

E-mail address: tdodge@gwu.edu

Prevalence of legal performance-enhancing substance use

There has been an increase in the number of legal dietary supplements available claiming to improve athletic/physical performance. Despite this increased availability, few studies have documented the prevalence of legal PES use. One study estimated that approximately one million adolescents between the ages of 12 and 17 years had used a performance-enhancing dietary supplement, but the number of adolescents in the sample was not reported, making it difficult to estimate the percentage of adolescents using legal PES [12]. Other studies report prevalence rates of legal PES in small, specialized or convenience samples. For example, in a sample of approximately 300 NCAA Division I athletes, Dodge and Jaccard [13] found that approximately 25% reported having ever used a legal PES and about 8% reported current use of a legal PES. Results also showed that males were more likely than females to report having used the substances. Another study that examined dietary supplement use in a sample of Canadian adolescents reported prevalence estimates ranging from 1.7% (for androstenedione) to 7.7% (for creatine) and found that males were more likely than females to use the supplements [14].

These studies suggest gender differences in the use of PES and imply that the use of legal PES is more common than the use of AS but are limited in scope and rely on convenience samples. Using a nationally representative sample of young adults from the United States, the present study examines prevalence estimates for the use of legal PES and AS. Gender differences in the use of such substances are also examined.

Performance-enhancing substance use and sports participation

There has been increasing interest in the impact of sports participation on the health of adolescents and young adults. Studies have linked sports participation to numerous positive and negative health outcomes [15–25]. The present study contributes to this literature by exploring the association between sports participation and the use of legal and illegal PES.

Some studies have suggested that athletes are at greater risk than non-athletes for using PES. In a study of high school students, athletes were more likely to report having used AS than non-athletes [26]. Another study found that adolescents who reported using a legal PES reported significantly more hours of physical activity than those who did not report supplement use [14]. Although research suggests a positive association between sports participation and use of PES, no studies have examined whether this relationship is a lasting one. The present study is unique in that it explores high school sports participation as a predictor of use of PES during young adulthood.

There are two plausible hypotheses with respect to this dynamic. One prediction is that participating in sports during adolescence increases the likelihood that one will use

PES in the future. The sporting context may provide a social environment that is unique from the environment to which non-athletes are exposed. One such aspect of the environment may be the information conveyed. The sporting environment may provide adolescent athletes with information about PES that is not as readily available to non-athletes. For example, adolescent athletes may receive information about the performance benefits associated with the use of PES from sources such as teammates or coaches. Information may also include which substances to purchase, where to purchase them, and how to use them. During young adulthood, those who want to improve physical/athletic performance or physical appearance may utilize the information obtained during adolescence. One prediction is that the sporting context during adolescence is associated with increased likelihood that one will use both AS and legal PES in the future.

An alternative prediction is that the effect of the sporting context on likelihood to use PES in the future is minimal. Although adolescents who participated in sports may have more information about PES, once these adolescents reach young adulthood, they are no longer interested in improving their athletic performance or physical appearance. These individuals likely have more knowledge than their non-athlete counterparts but lack the motivation they once had to use PES. A second hypothesis is that high school sports participation will have no meaningful relationship to the use of AS or legal PES in young adulthood. The present study examines these two competing predictions.

Relationship between steroids and legal performance-enhancing substances

It seems reasonable to believe there is a positive relationship between the use of AS and legal PES, although such a relationship has yet to be empirically tested. Such an association would be predicted from several different theoretical frameworks. Gateway Theory [27] predicts a positive relationship between the use of licit or legal substances (e.g., alcohol) and the use of hard or illicit substances (e.g., cocaine). According to Gateway Theory, there is a developmental trajectory or sequence of substance use, where the use of illicit substances is preceded by the use of licit substances. Such a framework would predict a positive relationship between the use of AS and legal PES.

It is also possible that the use of PES is part of a problem behavior cluster [4,28,29]. This conceptual framework states that risky behaviors in adolescents often co-occur because adolescents learn risk behaviors together, learn it is socially appropriate to engage in such behaviors simultaneously or the behaviors share some underlying cause (e.g., seeking independence). Based on these theoretical frameworks, we predict there will be a positive relationship between the use of AS and the use of legal PES.

The present research uses a nationally representative

sample to examine prevalence rates of AS and legal PES. We document gender differences in use and examine the relationship between sports participation and use of PES. We also explore the relationship between the use of AS and legal PES.

Method

Sample and procedure

The present study used the National Longitudinal Study of Adolescent Health (Add Health) data base [30]. From September 1994 through April 1995, an in-school self-administered questionnaire was administered during a class to students in grades seven to 12. All students who completed the in-school questionnaire, as well as those who were listed on the school roster, were used as a sampling frame to specify a sample of adolescents for in-home interviews. Follow-up data were collected from most of the in-home sample one year later (Wave II) and again six years later (Wave III). The present study uses data from the in-school questionnaire and from wave III.

Approximately 15,000 respondents were interviewed at Wave III. The interviews were conducted between August 2001 and April 2002. There was no significant non-response bias and non-response was taken into account with the use of sampling weights developed by the Add Health statisticians. The behavioral outcomes of steroid use and legal supplement use were assessed at Wave III and sports participation was assessed at Wave I. Institutional review board approval was obtained for analysis of the data set.

Measures

Steroid use. Use of AS was assessed using the dichotomous variable: "In the past year, have you used anabolic steroids or other illegal performance-enhancing substances for athletes?" Responses were scored 1 = yes and 0 = no.

Supplement use. Use of legal PES was assessed using the following dichotomous item: "In the past year, have you used a legal performance-enhancing substance for athletes (such as Creatine Monohydrate or Andro)?" Responses were scored 1 = yes and 0 = no.

Sport participation. Participants were asked to indicate which sport(s) they participated in from the following list: baseball/softball, basketball, field hockey, football, ice hockey, soccer, swimming, tennis, track, volleyball, wrestling, other. Responses were scored so that participation in at least one sport = 1 and non-participation = 0.

Demographic information. Gender was coded so that 1 = males and 0 = females. Five ethnic groups were created: Hispanic, Caucasian, non-Hispanic black, Asian and Native American. Age was calculated from self-reported birth dates. Participants reported whether they had received a

high school diploma (or the equivalent) and whether they were married. Responses were scored so that 1 = yes and 0 = no. A variable representing full-time employment (employed \geq 35 hours per week) was created for participants who were not currently enrolled in college, where 1 = full-time and 0 = part-time. Collegiate status was assessed such that 1 = currently enrolled in college or graduate school and 0 = not currently enrolled in college or graduate school. Participants self-reported total yearly personal income (in U.S. dollars). Gender was assessed at Wave I and all other demographic variables were assessed at Wave III.

Physical activity. Three variables representing current fitness behaviors were taken from the wave III data representing the number of times per week individuals participated in: team sports, individual sports, and strength-related activities (e.g., weight lifting). The stem of the questions read, "During the past 7 days, how many times did you participate in [individual sports]?" Responses ranged from 0 = not at all to 7 = 7 or more times.

Substance use. Three variables assessing use of other substances were taken from the Wave III data: binge drinking, use of drugs, use of injection drugs. Binge drinking was assessed by asking participants during the past 12 months on how many days they drank five or more drinks in a row. Responses included: 0 = none, 1 = 1 or 2 days in the past 12 months, 2 = once a month or less, 3 = 2 or 3 days a month, 4 = 1 or 2 days a week, 5 = 3 to 5 days a week, and 6 = every day or almost every day. Participants reported whether they had used illegal drugs (such as LSD, PCP, ecstasy, etc.) and whether they had injected any illegal drug (such as heroin or cocaine) in the past year. Responses were scored 1 = yes and 0 = no.

Analytic strategy

The two primary outcome variables are use of AS and use of legal PES within the past year. The primary predictor variables are gender and sports participation during adolescence. Logistic regression analyses were used in all analyses. Age, gender, and race/ethnicity (where whites served as reference group) were included as covariates in all analyses. Interactions were examined using both the logistic regression framework and a linear probability model. Sample weights developed by Add Health statisticians were used with the program SUDAAN [31] to derive parameter estimates.

Results

Prevalence estimates

Table 1 presents the demographic characteristics of the sample. About 8% of the sample reported having used a legal PES within the past year and about 1.6% reported having used AS within the past year. Males were more

Table 1
Demographic information for high school sports participants and adult performance-enhancing substance use

	Sample		Participate in sports		Use Legal PES		Use AS	
	Percentage	n	Percentage	n	Percentage	n	Percentage	n
Ethnicity								
Asian	3.5 (.7)	966	52.7 (3.38)	389	7.0 (1.49)	66	.5 (.29)	6
African American	15.7 (2.0)	2973	52.4 (2.03)	1235	5.0 (0.62)	153	1.8 (.41)	41
American Indian	.6 (.3)	112	51.3 (13.1)	34	8.5 (4.08)	7	4.0 (2.17)	3
Hispanic	11.8 (1.7)	2340	45.8 (2.75)	705	7.0 (.86)	180	2.0 (.50)	38
White	68.3(2.9)	7916	57.1 (1.52)	3492	9.5 (.50)	709	1.5 (.21)	95
Gender								
Male	50.8 (.6)	6759	62.5 (1.36)	3110	15.6 (.75)	1019	2.7 (.32)	153
Female	49.2 (.6)	7563	47.6 (1.59)	2752	1.1 (.18)	99	0.4 (.10)	30
Marital status								
Married	16.9 (.95)	2435	-	-	5.8 (.70)	144	1.3 (.38)	24
Not married	83.1 (.95)	11670	-	-	9.0 (.48)	974	1.6 (.18)	159
HS education								
Graduate or equivalent	88.6 (.75)	12694	-	-	9.0 (.44)	1047	1.5 (.16)	156
Not graduate	11.4 (.75)	1401	-	-	4.7 (.88)	70	2.4 (.71)	27
Employment status								
Full time	39.7 (1.26)	5494	-	-	9.2 (.64)	466	1.72 (.27)	81
Part time	60.3 (1.26)	8608	-	-	8.0 (.48)	652	4.5 (.22)	102
Collegiate status								
College/grad. school	35.2 (1.42)	5143	-	-	10.1 (.60)	474	1.4 (.30)	53
Not in college/grad.	64.8 (1.42)	8962	-	-	7.6 (.50)	644	1.7 (.21)	130
Age	21.3 (0.17)		-	-	21.3 (.23)	-	21.5 (.22)	-
Income	10,960 (512.16)		-	-	14,731 (836)	-	16,390 (1675)	-

Note: The standard errors are shown in shown in parentheses; median values are presented in bottom rows for age and income; standard errors and percentages are weighted values; n is actual sample size.

likely to use AS (2.7%) and legal PES (15.6%) than were females (.4% and 1.1%, respectively). Logistic analyses showed that males were nearly seven and a half times more likely than females to report having used AS within the past year (odds ratio [OR] 7.47, 95% confidence interval [CI] 4.06–13.74) and were about 16 times more likely to report having used legal PES in the past year (OR 16.05, 95% CI 11.6–22.1).

Sports participation and steroid use

Table 2 shows the percentage of respondents who reported using AS in young adulthood as a function of sports participation and gender. A logistic regression analysis indicated that sports participation was not statistically significantly associated with adult AS use (Exp β = 1.48, 95% CI .82–2.63). However, routine examination of model fit diagnostics suggested model misspecification due to an interaction between gender and sports participation. The logistic

model was re-estimated including a product term between these variables. In this re-specified model, the effect of sports participation was statistically significantly related to the odds of using steroids, but the effect was qualified by a statistically significant gender-sport interaction (Exp β = 3.81, 95% CI 1.21–11.97). As seen in Table 3, males are about four times (Exp β = 4.16, 95% CI 1.33–12.96) more likely than females to use AS (as indexed by odds) when they did not participate in sports during adolescence. By contrast, males were nearly 16 times as likely as females to use AS in young adulthood if they had participated in sports (Exp β = 15.87, 95% CI 5.98–42.14). Another way of conceptualizing this interaction is that the adverse effects of sports participation are concentrated in males, not females.

One reason the sporting context can influence AS use in young adulthood is because sports participation during adolescence may increase the value a person places on physical fitness and, in so doing, causes individuals to seek out

Table 2
Percentage of AS use and PES use by gender and sport participation

	AS use		PES use	
	Sport	No sport	Sport	No sport
Males	2.86	1.65	17.47	11.33
Females	.19	.40	1.01	1.00

Table 3
Steroid use predicted by gender and sports participation

	β	SE	p Value <	Exp (β)	95% CI
Intercept	-5.20	1.55	.01	.01	.00 to .12
Black	-.06	.35	.85	.93	.47 to 1.88
American Indian	1.63	.52	.01	5.13	1.82 to 14.38
Asian	-1.92	.80	.02	.15	.03 to .70
Hispanic	.37	.45	.42	1.45	.59 to 3.54
Age	-.01	.07	.89	.99	.85 to 1.14
Gender	1.42	.57	.02	4.16	1.33 to 12.96
Sport	-.78	.45	.09	.46	.18 to 1.13
Sport*gender	1.34	.58	.02	3.81	1.21 to 11.97

Note: chi-square change = 6.45, 1 df.

fitness-related environments as young adults. Perhaps it is these more immediate contexts that lead young adults toward steroid use. To test this possibility, AS use was regressed onto sports participation, gender, the sport-gender interaction, demographic covariates, the number of days per week the individual played a team sport, an individual sport, and engaged in some strength-related activity. The interaction effect remained statistically significant. The only fitness-related variable to reach statistical significance was the strength related variable (Exp β = 1.33, 95% CI 1.18–1.51).

Sport participation and supplement use

A logistic regression analysis revealed that adolescents who participated in sports during high school were about one and half times more likely (Exp β = 1.59, 95% CI 1.26–2.00) to report using a dietary supplement in young adulthood than those who did not participate in sports (p < .05). Results of this analysis are shown in Table 4. Although a gender by sport interaction term was not statistically significant when modeled in terms of log odds, model diagnostics for the logistic analysis suggested that using probabilities as the focus of analysis would produce a gender-sport interaction (see last two columns of Table 2, where the interaction using probabilities is apparent). As seen in Table 2, the proportion of male athletes who used legal PES was .17, compared with .11 for non-athletes (the difference is .06), and the predicted proportion of female athletes who

used legal PES was .01, compared with .01 for non-athletes (the difference is almost .00). These differences suggest that, although the ratios of the predicted odds in the two groups are not significantly different, the differences in the probabilities as a function of sports participation (.06 vs. .00) are different. The difference between these differences was statistically significant using a test based on a linear probability model (p < .01), confirming the interaction for probability differences.

To control for current exercise behaviors, the above analyses were repeated including the three physical fitness variables. Sports participation remained a statistically significant predictor of legal PES use even when current fitness and strength activities were held constant. Only the strength-related variable was statistically significant (Exp β = 1.40, 95% CI 1.33–1.48).

Steroid use and supplement use

To examine the relationship between legal PES use and AS use relationship, AS use was regressed onto legal PES use. Results indicate that those who reported using a legal PES were almost 26 times more likely to report having used AS than those who did not use a legal PES (Exp β = 25.97, CI 15.6–43.4). Results of this analysis are shown in Table 5 and are consistent with Gateway Theory.

To explore the applicability of Problem Behavior Theory, we tested whether use of AS and PES were related to binge drinking, drug use and injectable drug use in young

Table 4
Predicted odds of using legal dietary supplements

	β	SE	p Value <	Exp (β)	95% CI
Intercept	-.87	.68	.20	.42	.11 to 1.61
Gender	2.81	.21	.01	16.7	11.1 to 25.21
Age	-.04	.03	.20	.96	.90 to 1.02
Black	-.87	.16	.00	.42	.30 to .58
American Indian	-.85	.43	.05	.43	.18 to 1.01
Asian	-.26	.22	.24	.77	.49 to 1.20
Hispanic	-.18	.20	.37	.83	.56 to 1.24
Sport part.	.46	.12	.01	1.59	1.26 to 2.00

Table 5
Predicting anabolic steroid use from legal supplements and covariates

	β	SE	p Value <	Exp (β)	95% CI
Intercept	-6.96	1.24	.01	.001	.00 to .01
Black	.63	.28	.03	1.89	1.08 to 3.31
American Indian	1.23	.31	.01	3.41	1.85 to 6.33
Asian	-1.04	.68	.14	.35	.09 to 1.36
Hispanic	.58	.28	.05	1.78	1.02 to 3.11
Age	.04	.06	.44	1.04	.93 to 1.17
Gender	.81	.36	.03	2.23	1.09 to 4.52
Supplement use	3.26	.26	.01	25.97	15.6 to 43.4

adulthood. Correlations between use of AS and each of these variables was .04, .09 and .39, respectively. Use of legal PES was correlated with the three behaviors .16, .09 and .10, respectively. In general, the correlations are low and do not suggest that use of AS and PES is part of a broader cluster of problem behaviors.

Discussion

Using a nationally representative sample of young people, the present study examined the use of AS and legal PES in young adulthood. Results of the study suggest that the use of legal PES is more prevalent than the use of AS. The present study also found that males were more likely to have used a legal PES than were females. Few studies have documented such a gender difference and this study is one of the first to do so in a nationally representative sample.

A gender-sport participation interaction was observed when predicting AS use such that the differences between males and females in AS use were greater for those who participated in sports than for those who did not participate. This relationship probably reflects differences in the sporting environment surrounding males and females. Sports played by males often demand more muscle than those played by females and this difference might have encouraged males to see greater utility in the use of AS than females. As a result, male athletes were more likely than female athletes to have been exposed to a social environment that condones or supports the use of AS as a way of improving athletic/physical performance. Such an environment might have led male athletes to be less fearful of the dangers of using AS. Once these adolescents reach young adulthood, they may be more likely to use AS than female athletes and their non-athlete counterparts. Future research should examine these possibilities and explore other psychological mechanisms that may be responsible for these observed differences.

The present study found that sports participation during adolescence is associated with an increased likelihood that one uses legal PES in young adulthood, independent of demographic characteristics and current physical activity. There are many reasons why the sporting context may exert such lasting effects. It is possible that high school athletics

provides adolescent athletes with knowledge about the use of legal PES as an avenue for improved physical/athletic performance. Another possibility is that the high school sporting context serves to reduce risk perceptions of legal PES use. Future research should explore these and other possibilities to help gain a better understanding of the lasting effect of high school sports on the use of legal PES.

The proportion of males who have used a legal PES was greater than the predicted proportion of females, and this difference was greater for athletes than for non-athletes. This suggests that the sporting context may have a more pronounced effect on the proportion of males who use legal PES than on the proportion of females who use legal PES.

Consistent with predictions from Gateway Theory, results of the present study suggest a sizeable positive relationship between using AS and the use of legal PES. What remains unanswered is whether there is a sequential pattern to the use of PES. To distinguish this, future research needs to identify whether there is a temporal pattern of PES use that begins with legal, relatively benign PES and progresses to illicit, fairly dangerous AS. This was not possible with the current data. At present, Gateway Theory remains a tenable possibility. By contrast, results failed to support a Problem Behavior Theory explanation that views use of AS and legal PES as part of a broader problem behavior complex.

Results of the present study have a number of practical implications. That the use of PES is greater among males than females suggests that prevention efforts are particularly important for males. Young people appear more likely to use legal PES than AS, highlighting the importance of intervention and prevention efforts targeting legal PES. That sports participation can have lasting effects on legal PES use emphasizes the value of targeting the high school sporting context for prevention efforts.

Although this study offers a number of contributions to existing literature on PES use in adolescents and young adults, it is not without limitations. The study was correlational, so causality cannot be inferred. It is possible that participants underreported their use of PES although self-reports were made under conditions that emphasized confidentiality. Measurement error is associated with the measures, which can bias standard errors and parameter

estimates. Despite these shortcomings, we feel these results make important contributions to existing literature on PES use.

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