ORIGINAL ARTICLE

Drug Testing Athletes to Prevent Substance Abuse: Background and Pilot Study Results of the SATURN (Student Athlete Testing Using Random Notification) Study

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Purpose: **To assess the deterrent effect of mandatory, random drug testing among high school (HS) athletes in a controlled setting.**

Methods: **Two high schools, one with mandatory drug testing (DT) consent before sports participation, and a control school (C), without DT, were assessed during the 1999–2000 school year. Athletes (A) and nonathletes (NA) in each school completed confidential (A) or anonymous (NA) questionnaires developed for this study, respectively, at the beginning and end of the school year. Positive alcohol or drug tests required parent notification and mandatory counseling without team or school suspension. Thirty percent of the DT athletes were tested. Data were analyzed using the end of the school year measure, adjusted for the initial questionnaire results. Demographics of the athlete sample revealed that mean age was 15.5 years with 81.5% white, 9.6% Hispanic, 4.5% Asian, 2.6% American Indian/Native Alaskan, 1.3% African-American, and 1.3% Native Hawaiian/Pacific Islander.**

Results: **A (n = 276) and NA (n = 507) were assessed at the beginning (baseline) and at the end of the school year (A, n = 159; NA, n = 338). The past 30-day index of illicit drugs (4-fold difference) and athletic enhancing substances (3-fold difference) were lower ($p < .05$) among DT athletes at follow-up without difference in alcohol use. However, most drug use risk factors, including norms of use, belief in lower risk of drugs, and poorer attitudes toward the school, increased among DT athletes ($p < .05$). Although a reduction in the illicit drug use index was present among nonathletes at the DT school, at the end of the school year, it did not achieve statistical significance ($p < .10$).**

Conclusions: **Random DT may have reduced substance use among athletes. However, worsening of risk factors and small sample size suggests caution to this drug prevention approach. A larger long-term study to confirm these findings is necessary. © *Society for Adolescent Medicine, 2003***

KEY WORDS:
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High school athletes are not protected from harmful behaviors and, in general, use illicit drugs at high rates similar to their nonathlete peers [1,2]. These adolescents often report higher use of anabolic ste-

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roids and other athletic enhancing substances [2–9]. Currently, high school sports comprise 50% of a school's enrollment with comparable representation between genders [10]. The importance of preventing drug use among athletes is heightened by their elevated social status among peers, and potential influence among younger adolescents [11,12]. Moreover, adolescence represents a window of opportunity for prevention, because deterring drug use during this period is associated with a lifetime reduction in substance abuse [13].

Over the past 25 years drug testing has been used at various levels, including U.S. Junior amateur (e.g., high school-age students at regional and national meets), collegiate, professional, and Olympic athletes [14–16]. Recently, drug testing has extended to high school athletics [17–20]. In 1995 the U.S. Supreme Court upheld a policy of drug testing adolescents engaged in school sports after this type of surveillance was challenged in an Oregon school district [17]. Schools have considered and implemented athlete drug testing using a variety of protocols, despite the absence of efficacy studies [18,19,21,22].

Given the growth in random testing of high school student athletes, we desired to determine whether this policy actually reduces illicit substance use. If the threat of drug testing can reduce initiation or curtail alcohol and drug (AOD) use, then the policy may be a viable option to supplement other prevention efforts. However, if random surveillance does not affect AOD use, then current drug testing resources should be redirected to other prevention efforts.

During mid-1999, the National Institute on Drug Abuse funded the SATURN (Student Athlete Testing Using Random Notification) project. This investigation is studying the effects of a program similar to the U.S. Olympic Committee's No Advanced Notice intervention as a model [20], which is currently used by the U.S. Antidoping Agency. Because SATURN's primary objective is to assess whether the use of AOD can be prevented or uncover substance abuse problems, the identification of users is intended to hasten evaluation. Parental notification, counseling referral, and a single-game suspension were the consequences of a positive test, rather than enforcement of punitive consequences such as incarceration, a criminal report, team dismissal, or school suspension. However, if counseling was refused, student athletes could not participate in sports. Thus, the SATURN study is designed to determine whether a nonpunitive, mandatory, random, suspicionless drug testing policy is an effective deterrent to drug and alcohol use among high school athletes.

We report the findings of the pilot study, observing the effects of a prospective, controlled evaluation.

Methods

School Recruitment

Two Oregon high schools were recruited as participants. Neither had drug testing programs before the study. The intervention school was self-selected, responding to media announcements of grant funding. Students at the intervention school were aware of their upcoming drug surveillance policy more than 3 months before the beginning of the school year (Fall 1999). The control school was recruited from another district, similar in size, demographics, and number of students participating in school-based athletics.

Participant Consent

Because random, suspicionless drug testing was school policy at the intervention school, completing a consent for mandatory drug testing was a requirement for all athletes. Student-athletes at the control and intervention schools were invited to participate in similar surveys, and students and their parents provided consent for questionnaire administration using a confidential, code-numbered instrument. Nonathletes were recruited for anonymous questionnaires by a parent/student letter. These procedures and instruments were approved by the Institutional Review Board of the Oregon Health and Science University.

Questionnaire

The 121-item self-report survey was developed from national questionnaires and earlier research [23–26]. Surveys were administered before (late Summer 1999), and at the conclusion of, the school year. Most belief, attitude, drug use risk, and protective factor responses were measured on a seven-point agreement scale used in prior studies [25,26]. Individual items were grouped as constructs to assess theoretical risk and protective factors and program outcomes [13]. Constructs included negative and positive consequences of drug use, norms among peers and authority figures, risky behavior, attitudes toward school, attitudes toward drug testing, perceived benefits of drug testing, perceived likelihood of being

drug-tested, beliefs about drug testing efficacy, fear of drug testing consequences, psychological reactance, and drug testing as a reason not to use drugs.

Substance use outcomes were use of alcohol, illicit drugs, ergogenic substances, and "athletic" supplements. The illicit drug index included measures of marijuana, cocaine in any form, amphetamines/methamphetamines, narcotics, phencyclidine (PCP), and inhalants. The ergogenic substance index included athletic enhancing drugs comprising anabolic androgenic steroids, amphetamines, and methamphetamines, plus pseudoephedrine, other over-the-counter stimulants, anabolic steroid precursor, androstenedione, and creatine. An additional index included the ergogenic drugs without athletic supplements. Follow-up questionnaires were identical to the pre-intervention questionnaire, with a few additional items concerned with drug testing experiences.

Nonathletes were not subject to drug testing at either school but these students were asked to complete anonymous questionnaires to assess overall substance use at each school at both time points. Although the athlete and nonathlete surveys were similar, several attitude constructs regarding sports were not included on the nonathlete survey. Because of anonymity, nonathlete questionnaires could not be matched for pre- and post-intervention results.

For a minimum of 3 months before their initial survey, the experimental school's athlete group knew they would be subject to random drug testing during the upcoming school year. The control athletes knew they would not be tested and serve as controls for the entire school year. Thus, the initial (beginning of the school year) assessment was not strictly "baseline," especially for the past 30-day use, as intervention athletes knew they were subject to testing immediately after completing the survey. This situation was unavoidable, as control and experimental sites had been determined months in advance of survey administration. The drug testing policy required prior school board approval and lengthy open discussion on this issue, with the assistance of legal counsel.

Drug Testing Policy

Although participation in the SATURN surveys was voluntary, the drug testing program was a school policy and an absolute prerequisite for sport participation. Athletes and their parents consented to the school-imposed testing when providing permission to play school sports. Athletes at the experimental school were eligible for testing during the entire school year, not just during their sport season(s), and each athlete had the same chance of being tested during each of the 15 random testing days. Several athletes were tested on each specimen collection day, such that 30% of the athletes were tested at some point during the school year.

Drug Testing Procedure

School officials were notified the day before, or the day of, testing, which insured that the school was in session. When physician testers arrived at the site, the principal or school counselor was provided the names of students selected for testing. If a student was absent, a replacement athlete was selected. The "absent" athlete was then tested during the next random visit without prior knowledge that he/she had previously been chosen. Student athletes were immediately excused from class to a "holding" room, where procedures for urine collection were explained. The athlete proceeded to the collection area, accompanied by a same-gender physician tester. All specimen collection was overseen by certified United States Olympic Committee Crew Chiefs, trained in urine collection procedures and chain of custody. Collection was directly visualized but for the one student who accepted the offer to use a "modesty" drape. The drape is a skirt-like lap barrier that allowed observation to detect addition of foreign substances into the specimen, but not direct visualization of voiding.

The athlete voided a minimum of 100 ml into the collection vessel containing an impregnated temperature strip. The athlete transferred, under observation, a portion of the sample (approximately 30 ml) to specimen container A and specimen container B. The remaining portion was assessed for pH and specific gravity, to guard against overdilution and use of alkalinizing agents. The containers were sealed with tamper-evident tape containing a temporary specimen transfer number identical to the number on the triplicate drug testing Chain of Custody form. After sealing, the student signed the testing form, certifying that the urine specimen was his/her sample. The containers were then placed in a plastic bag along with the laboratory's version of the chain of custody form, secured with another tamper evident seal, and sent anonymously to the laboratory by express mail. A list of names of students tested, including their temporary transfer number, was left with the school principal or counselor.

Laboratory Drug Testing

Substances assessed included alcohol, marijuana, cocaine, narcotic analgesics, PCP, amphetamines, methamphetamines, sedative hypnotics, and anabolic steroids. Quest Diagnostic Laboratory (San Diego, CA, USA), a DHHS-certified laboratory, performed testing on all specimens.

Initial screening tests were performed with enzymatic immunoassay of the A sample. If the test found an illicit or controlled substance, gas chromatography-mass spectrometry was used, as the latter method of analysis is recognized in the legal setting and improves result reliability [27,28].

Although no challenges to results occurred, students could request the unopened B sample be analyzed by another DHHS-certified laboratory of their choice. During the course of the school year, some B samples were sent to one of the Olympic Certified Laboratories (Indiana University) for confirmation.

Consequences of a Positive Test

A student athlete's positive result was discussed by the school principal and parent(s)/guardian(s), with a mandatory meeting between the student and a drug and alcohol counselor, paid for by the student's family. However, a school district substance abuse counselor was available at no charge to the family. The student remained in school and on the team, without recording the positive result in his or her academic record. The counseling session was intended to identify whether the student was beyond the "experimentation" stage of drug and/or alcohol use, which could require a more aggressive therapeutic approach. The experimental school chose to enforce a one-game suspension, in addition to the mandatory counseling session. Law enforcement authorities were not involved. No school or team suspension was to occur unless the student refused counseling.

Statistical Analysis

The items that formed each theoretical construct were analyzed using principal factor analysis. Cronbach alpha was calculated to assess the internal reliability of the constructs.

Drug use indices were analyzed several ways. For athletes and nonathletes, lifetime, past year, and past 30-day drug use were analyzed. For athletes, the new-lifetime analyses examined drug use at the postseason and consisted of only those students who did not use drugs at the preseason.

Conditional regression models for athletes' data were estimated that included the initial questionnaire measurement as a covariate. The end-of-the-school-year measures were the dependent variable, and program exposure was the independent variable. Program effect estimates were the difference between the control and the drug testing groups at the end of the school year, adjusted for the beginning of the school year levels. The covariates of ethnicity (white vs. nonwhite) and grade point average were included in the models because there were differences between the groups in these measures. Conditional logistic regression analysis was used for the binary drug use indices. The analyses for nonathletes were similar to the athletes' analyses, but the regression model included a variable coding time, preseason versus postseason, rather than including the preseason measurement as a covariate. In this model, the interaction representing the differential change in the outcome measured across drug testing and control groups was the primary test of the drug testing effect. Because of anonymous questionnaire use, subjects could not be matched for the nonathlete data. Thus, tests of the effects have less statistical power than the test for athletes.

Results

Subject Retention

Student attrition among the athletes was expected from three sources: team withdrawal, school transfer, and study withdrawal. A total of 276 adolescent athletes (135 experimental and 141 control) were enrolled in the study and assessed at baseline. This represented 40% and 46% of each school's entire student body population, respectively. Of student athletes assessed preseason, 57% (n = 159; 97 experimental and 62 control $p < .05$) were assessed at school year's end. Two participants from the drug testing group were dropped from the analyses because their questionnaire responses were not usable. The personal drug use recorded by student athletes at pre-intervention (survey #1) who did not take the end of the school year survey (survey #2) was not different at control and intervention schools, suggesting that differential attrition (e.g., difference in those engaged in drug use) was not present, increasing the validity of the results [24,29].

Samples of nonathletes were assessed at the beginning and end of the school year. A total of 507

Table 1. Individual Level Comparisons of Demographic Characteristics Between the Experimental and Control Students at the Pretest

Demographics	Control	Experimental
Athletes present at pretest and posttest	n=62	n=95
Age (in years), mean (SD)	15.6 (1.2)	15.5 (1.1)
Grade point average, mean (SD)[a]	2.3 (1.1)	2.4 (1.1)[b]*
Gender, % male	51.6	51.6
Race/ethnicity, %		
Asian	6.5	3.2
Native Hawaiian/Pacific Islander	0.0	2.1
American Indian/Native Alaskan	0.0	4.2
Hispanic/Latino	3.2	13.7*
Black/African-American	1.6	1.1
White	88.7	76.8*
Nonathletes	n = 113	n = 168
Age (in years), mean (SD)	15.7 (1.2)	15.8 (1.3)
Grade point average, mean (SD)[a]	2.3 (1.1)	2.4 (1.3)
Gender, % male	50.9	50.0
Race/ethnicity, %		
Asian	3.6	1.8
Native Hawaiian/Pacific Islander	1.8	0.6
American Indian/Native Alaskan	7.2	6.5
Hispanic/Latino	4.5	23.2*
Black/African-American	0.9	1.2
White	83.8	67.9*

*$p < .05$.
[a] Where 2 = B+ and 3 = B
[b] Grade point average was higher in drug testing group.

nonathletes were assessed by questionnaire; 338 at baseline (113 control and 168 experimental) and 226 (117 control and 109 experimental) at the follow-up.

Baseline Characteristics

The average age of the athletes was 15 years and 6 months. The athlete sample was 81.5% white, 1.3% African-American, 9.6% Hispanic, 4.5% Asian, 2.6% American Indian/Native Alaskan, and 1.3% Native Hawaiian/Pacific Islander. Table 1 shows demographic characteristics for the athletes at both the beginning and conclusion of the school year. Athletes in the drug testing group had a higher grade point average ($p < .05$), were more likely to be Hispanic students ($p < .05$), and less likely to be white students ($p < .05$). Therefore, all program effect analyses were adjusted for grade point average and ethnicity.

The average age of the nonathletes was 15 years and 9 months. The nonathlete sample was 75.9% white, 1.0% African-American, 14.5% Hispanic, 2.6% Asian, 5.8% American Indian/Native Alaskan, and 1.4% Native Hawaiian/Pacific Islander. Table 1 shows the nonathlete demographic characteristics assessments by group. Similar to the athletes, the nonathletes in the drug testing school had more Hispanic students ($p < .05$) and were less likely to be white ($p < .05$).

Construct Reliabilities

Table 2 shows the questionnaire items that form the constructs and Cronbach alpha at baseline for athletes and nonathletes. Because the nonathlete questionnaire had fewer survey items, several constructs could not be measured in this group, and other constructs contained fewer items than the athlete constructs. The differences between the athlete and nonathlete questionnaire items are shown in Table 2.

Baseline Equivalence of Constructs and Drug Use Indices

Baseline equivalence was assessed for each construct. The athletes in the drug testing group reported the following: less belief in negative consequences of drug use ($p < .05$) and greater belief in the positive consequences of drug use ($p < .05$); more risky behavior ($p < .05$), believed their peers used more

Table 2. Constructs and Reliabilities

	$\alpha_{Athlete}$	$\alpha_{Nonathlete}$
1. Negative consequences of drug use (Higher mean indicates more negative consequences)	0.83	
2. Positive consequences of drug use (Higher mean indicates more positive consequences)	0.88	
3. Descriptive norms: peers (Higher mean indicates believe peers use more drugs)	0.90	0.90
4. Injunctive norms: peers (Higher mean indicates more disapproval)	0.75	0.80
5. Injunctive norms: authority figures (Higher mean indicates more disapproval)	0.91	
6. Risky behavior (Higher mean indicates riskier behavior)	0.75	
7. Positive attitudes toward school (Higher mean indicates more positive attitudes)	0.70	0.82
8. Positive attitudes toward drug testing (Higher mean indicates more positive attitudes)	0.82	0.87
9. Positive beliefs regarding testing benefits (Higher mean indicates more benefits)	0.82	
10. Perceived likelihood of being tested (Higher mean indicates more likely)	0.33	
11. Beliefs about testing efficacy (Higher mean indicates more efficacious)	0.43	0.43
12. Fear of consequences (Higher mean indicates more fear)	0.55	
13. Reactance (Higher mean indicates more reactance)	0.77	0.72
14. Testing as a reason not to use (Higher mean indicates testing is a reason not to use)	0.77	0.78

drugs ($p < .05$), and believed that their peers and authority figures were more tolerant of drug use (both $p < .05$). Also, athletes subject to drug testing had less positive attitudes toward drug testing ($p < .05$), less belief in testing efficacy ($p < .05$), and less belief in the potential benefits of testing ($p < .05$). Athletes in the experimental school also had less fear of the consequences of testing positive ($p < .05$), and reported more reactance toward drug surveillance ($p < .05$). The results reflected a greater overall risk for drug use among the drug testing school's athletes, based on higher scores on risk factors than the control school athletes [13,23].

The only statistically significant difference between the groups in preseason drug consumption was for lifetime ergogenic substance use. Athletes in the drug testing group reported less use of performance-enhancing substances (AAS, androstenedione, amphetamines, creatine, pseudoephedrine, and other over-the-counter stimulants) than the control group athletes ($p < .05$), but athletes in the experimental and control group had similar past year and past 30-day use.

Program Effects—Athletes

Table 3 shows the attitude and drug use means (and standard deviations) for the drug testing and control group athletes both before and after the drug testing intervention. Parameter estimates, standard errors, and statistical significance from regression analyses are also shown.

Past 30-day illicit drug (illicit drug index) use for athletes in the drug testing group decreased, whereas monthly use for control athletes increased from the beginning of the school year to conclusion of the year ($p < .05$) (Table 3). Although control athletes increased their use of ergogenic substances (athletic substance use index), athletes in the drug testing group decreased their use from the beginning to the end of the school year ($p < .05$). Although a similar pattern was observed for ergogenic drugs without over-the-counter stimulants, the difference was not statistically significant. There were no differences between experimental athletes who were tested and those subject to testing but not tested.

Table 3. Athletes Drug Use Proportions and Attitude Construct Means (and Standard Deviations) for the Experimental and Control Groups Before and After the Drug Testing Intervention

	Control		Treatment		
	Pretest Mean (SD)	Posttest Mean (SD)	Pretest Mean (SD)	Posttest Mean (SD)	Group Effect β (SE)
New lifetime drug use (Use at the posttest by students who had not used at the pretest)					
Any drugs	0.000	0.364 (0.481)	0.000	0.400 (0.490)	0.546 (1.071)
Alcohol	0.000	0.313 (0.464)	0.000	0.478 (0.500)	0.671 (0.703)
Tobacco	0.000	0.167 (0.373)	0.000	0.233 (0.423)	0.395 (0.659)
Illicit drugs	0.000	0.128 (0.334)	0.000	0.327 (0.469)	1.029 (0.579)**
Ergogenic drugs	0.000	0.096 (0.295)	0.000	0.107 (0.309)	0.195 (0.599)
Ergogenic substances	0.000	0.118 (0.323)	0.000	0.129 (0.335)	0.219 (0.653)
Past 30-day drug use					
Any drugs	0.339 (0.473)	0.417 (0.493)	0.333 (0.471)	0.309 (0.462)	−0.431 (0.379)
Alcohol	0.183 (0.387)	0.183 (0.387)	0.215 (0.411)	0.247 (0.431)	0.348 (0.427)
Tobacco (smoked or chewed)	0.373 (0.484)	0.386 (0.487)	0.405 (6.491)	0.306 (0.461)	−0.144 (0.098)
Illicit drugs	0.065 (0.247)	0.194 (0.395)	0.074 (0.262)	0.053 (0.224)	−1.531 (0.600)*
Ergogenic drugs	0.049 (0.216)	0.113 (0.317)	0.053 (0.224)	0.032 (0.176)	−1.264 (0.806)
Ergogenic substances	0.150 (0.357)	0.226 (0.421)	0.098 (0.297)	0.053 (0.224)	−1.799 (0.677)*
Attitudes and beliefs					
Attitudes toward school	5.062 (1.315)	4.855 (1.393)	4.737 (1.306)	3.842 (1.328)	−0.878 (0.194)*
Negative consequences of drug use	5.915 (1.072)	5.877 (1.003)	5.211 (1.370)	5.179 (1.142)	−0.462 (0.171)*
Positive consequences of drug use	2.165 (1.262)	2.391 (1.175)	2.616 (1.422)	2.787 (1.177)	0.285 (0.179)
Descriptive norms about peers	4.373 (1.734)	4.207 (1.607)	5.763 (2.171)	5.826 (1.961)	1.146 (0.281)*
Injunctive norms about peers	2.851 (1.205)	3.023 (1.280)	3.422 (1.248)	3.628 (1.212)	0.326 (0.175)**
Injunctive norms about authority figures	1.525 (0.940)	1.540 (0.901)	2.116 (1.399)	2.179 (1.287)	0.570 (0.182)*
Risky behavior	2.676 (1.297)	2.569 (1.333)	3.146 (1.397)	3.170 (1.168)	0.411 (0.179)*
Fear of consequences	4.626 (0.997)	4.552 (1.053)	4.178 (1.079)	4.087 (1.022)	−0.209 (0.163)
Attitudes toward drug testing	5.003 (1.585)	4.613 (1.626)	4.400 (1.662)	4.040 (1.645)	−0.312 (0.231)
Beliefs about testing efficacy	4.847 (1.081)	4.863 (0.942)	4.416 (1.180)	4.274 (1.108)	−0.480 (0.169)*
Beliefs regarding testing benefits	4.868 (1.210)	4.633 (1.112)	4.412 (1.396)	3.983 (1.206)	−0.414 (0.162)*
Likelihood of being tested	4.557 (2.179)	4.642 (1.947)	5.700 (1.897)	4.622 (1.697)	−0.539 (0.353)
Psychological reactance	1.994 (0.968)	2.335 (1.038)	2.663 (1.224)	2.883 (1.195)	0.294 (0.163)**
Testing as a reason not to use	4.610 (1.301)	4.543 (1.249)	4.704 (1.276)	4.299 (1.179)	−0.279 (0.179)

* $p < .05$; ** $p < .01$.

Note. The "illicit drug" index includes marijuana, cocaine, amphetamines, narcotics, sniffing glue or paint, and phencyclidine (PCP). The "ergogenic drug" index includes anabolic steroids, androstenedione, and amphetamines. The "ergogenic substance" index includes anabolic steroids, androstenedione, amphetamines, creatine, and pseudoephedrine. The "any drugs" index includes all listed drugs. Logistic regression was used for the analysis of the drug use measures.

New drug use. The initiation of drug use among students who never used drugs was no different between control and intervention schools during the course of the school year.

Drug use consequences and norms. Because of the differences in beliefs and attitudes found in the initial surveys, all group differences were adjusted for baseline attitudes. At the conclusion of the school year, athletes in the drug testing group believed that drug use resulted in fewer negative consequences than athletes in the control group ($p < .05$), but there was no significant difference between the groups in their perceived positive consequences of drug use. Athletes subject to drug testing thought that authority figures were more tolerant of drug and alcohol use than the athletes in the control school ($p < .05$). Additionally, athletes in the drug testing group indicated more preference for risky drug use behavior than the athletes in the control group ($p < .05$), and believed that their peers used more drugs and drank more alcohol than athletes in the control group ($p < .05$) at the conclusion of the intervention.

Attitudes toward school. There was a larger reduction in positive attitudes toward school from the beginning of the school year to the end of the year for athletes in the drug testing group compared with athletes in the control group ($p < .05$). There was no difference in attitudes between the athletes who were actually tested and those who were subject to testing but not tested at the experimental school.

Table 4. Nonathletes Drug Use Proportions and Attitude Construct Means (and Standard Deviations) for the Experimental and Control Groups Before and After the Drug Testing Intervention

	Control		Treatment		Group* Time Interaction β (SE)
	Pretest Mean (SD)	Posttest Mean (SD)	Pretest Mean (SD)	Posttest Mean (SD)	
Lifetime drug use					
Any drugs[a]	0.809 (0.393)	0.795 (0.404)	0.822 (0.383)	0.835 (0.371)	0.030 (0.121)
Alcohol	0.757 (0.429)	0.754 (0.431)	0.770 (0.421)	0.787 (0.409)	0.009 (0.112)
Tobacco (smoked or chewed)	0.667 (0.471)	0.672 (0.469)	0.706 (0.456)	0.679 (0.467)	−0.051 (0.100)
Illicit drugs	0.545 (0.498)	0.603 (0.489)	0.609 (0.488)	0.578 (0.494)	−0.115 (0.095)
Ergogenic drugs	0.230 (0.421)	0.231 (0.421)	0.202 (0.401)	0.174 (0.379)	−0.048 (0.113)
Ergogenic Substances[a]	0.241 (0.428)	0.284 (0.451)	0.221 (0.415)	0.222 (0.416)	−0.060 (0.107)
Past 30-day drug use					
Any drugs[a]	0.482 (0.500)	0.509 (0.500)	0.553 (0.497)	0.556 (0.497)	−0.041 (0.095)
Alcohol	0.268 (0.443)	0.366 (0.482)	0.404 (0.491)	0.417 (0.493)	−0.118 (0.099)
Tobacco (smoked or chewed)	0.373 (0.484)	0.386 (0.487)	0.405 (0.491)	0.306 (0.461)	−0.144 (0.098)
Illicit drugs	0.239 (0.426)	0.322 (0.467)	0.327 (0.469)	0.266 (0.442)	−0.183 (0.103)**
Ergogenic drugs	0.045 (0.207)	0.095 (0.293)	0.075 (0.263)	0.064 (0.245)	−0.255 (0.186)
Ergogenic substances[a]	0.054 (0.226)	0.112 (0.315)	0.092 (0.289)	0.083 (0.276)	−0.241 (0.170)
Attitudes and beliefs					
Attitudes toward school	4.073 (1.718)	3.655 (1.626)	4.013 (1.559)	3.801 (1.675)	0.061 (0.074)
Descriptive norms about peers	4.693 (2.552)	5.193 (2.217)	4.983 (2.346)	5.549 (2.205)	0.020 (0.108)
Injunctive norms about peers[b]	3.900 (1.741)	3.744 (1.616)	4.022 (1.668)	4.035 (1.659)	0.022 (0.076)
Risky Behavior[b]	3.591 (2.190)	3.607 (2.013)	3.852 (2.050)	3.963 (2.087)	0.012 (0.095)
Attitudes toward drug testing	3.887 (1.707)	3.643 (1.713)	3.581 (1.889)	3.502 (1.788)	0.049 (0.080)
Beliefs about testing efficacy	3.650 (1.364)	3.560 (1.425)	3.578 (1.346)	3.333 (1.394)	−0.036 (0.063)
Psychological reactance[b]	3.468 (1.698)	3.295 (1.767)	3.731 (1.976)	3.601 (1.804)	−0.003 (0.084)
Testing as a reason not to use[b]	3.557 (1.501)	3.423 (1.549)	3.534 (1.462)	3.381 (1.421)	0.004 (0.068)

* $p < .05$; ** $p < .10$.

Note. The "illicit drug" index includes marijuana, cocaine, amphetamines, narcotics, sniffing glue or paint, and phencyclidine (PCP). The "ergogenic drug" index includes anabolic steroids, androstenedione, and amphetamines. The "ergogenic substance" index includes anabolic steriods, androstenedione, amphetamines, and creatine. The "any drugs" index includes all listed drugs. Logistic regression analysis was used for the drug use measures.

[a] Index does not include pseudoehpedrine that is part of the athlete index.

[b] Construct does not have all the times that are part of the athlete constructs.

Drug testing attitudes and beliefs. Although the athletes in both the drug testing and control groups held equally positive attitudes toward drug testing (e.g., both groups believed drug testing, in general, is a good idea), athletes in the drug testing group believed there were fewer benefits (e.g., not believing as strongly that testing reduces sports injuries) than athletes in the control group ($p < .05$). Athletes subject to drug testing believed that testing was less able to detect true drug users than athletes in the control group ($p < .05$).

In summary, although past 30-day illicit substance use and athletic enhancing substance use decreased among athletes in the experimental condition, use of alcohol did not change and these students reported higher theorized risk factors for drug use [13,23].

Program Results—Nonathletes

Nonathletes were not subject to drug surveillance testing. Table 4 shows the means (and standard deviations) for the nonathletes in the drug testing and control school at preseason and postseason. The table also shows the parameter estimate for the interaction between group (control and drug testing) and time (preseason and postseason), the standard error, and statistical significance level. There were no significant differences in nonathlete self-reported lifetime substance use between the experimental drug testing and control school nonathletes for any drug use measure.

Despite the finding that attitudes were significantly different among athletes at the experimental and control schools, no differences in beliefs and attitudes were found between the control and drug testing schools' nonathletes. This included attitudes about drug use prevalence, norms, the school, drug testing, and psychological reactance.

Discussion

Although the legality of drug testing adolescent athletes has been upheld by the U.S. Supreme Court

[17], there have been no prospective, controlled studies to substantiate the prevention efficacy of biological testing programs [30]. The present pilot study is the first to investigate adolescent athlete drug testing or any drug testing program in a controlled fashion.

The drug testing policy may have led to significant reductions in athletes' past 30-day use of both athletic enhancing substances and illicit drugs at the end of the school year. Also, these findings were present despite the predetermined knowledge of upcoming random surveillance, immediately after questionnaire completion, which could account for some of the difference in attitudes and 30-day drug use of control and experimental athletes at the initiation of the study. The reduction occurred although experimental student attitudes and risk factors would favor greater substance abuse among those athletes who were at risk for random testing [13]. These potential risk factors of drug use included believing in less negative consequences of drug use, reporting more risky behavior, perceiving greater peer drug use, and the belief that their peers and authority figures were more tolerant of use. Interestingly, there were no statistically significant risk factor differences between nonathletes at the control and experimental school, neither of which were subject to drug testing. Given the consistent attitude differences, among athletes only, it is reasonable to conclude that knowledge of the drug testing affected students' responses and resulted in these attitudes becoming even more negative at the end of the school year. Although there was attrition of this sample, owing to student transfer, discontinuing or never participating in sports during the school year, or refusal to complete the final survey, there was no statistically significant differential attrition among high-risk student-athletes or students admitting to drug use that would alter the analysis [29].

Despite the findings of reduced past 30-day illicit and ergogenic substance use, athletes in the drug testing group believed that testing was less effective and produced fewer perceived benefits. These negative features may be owing to the fact that drug testing was a new school policy, and the perception that this change resulted in the loss of the students' individual freedom [31].

Of interest, neither alcohol nor tobacco use was altered during the investigation. This may be owing to the fact that tobacco use was not among the tested substances and that students knew alcohol was difficult, if not impossible, to detect 1 day after use.

Before these findings, there were several theoretical reasons suggesting why drug testing could be an effective deterrent. Some research has found that when students believe schools and parents are explicit about intolerance to drug use, there is less drug and alcohol use [32]. Although parental consent and school initiation of a mandatory drug surveillance program could send a message that substance abuse is not tolerated, parental factors were not present in this study. Also, the potential for a drug test could provide a reason to resist drug and alcohol offers. However, in this pilot study students subject to drug surveillance did not believe that drug testing was a reason to decline drug offers. Despite these findings, the concurrence of the decrement in use and increase in attitudes favoring drug use among athletes in the intervention school may reflect the importance of the immediacy of the consequences. The tangible results of testing may be more of a relevant factor in deterring drug use than other factors. This result is consistent with prior studies, which have shown that programs emphasizing adverse effects that occur at a distant time (e.g., addiction and untoward physical and emotional effects) have not been effective in reducing substance abuse [13].

There are limitations to this study. Although there is an experimental and control school, they were not randomized, but rather self-selected. The dropout rate was moderate. This could potentially affect the analysis if more drug using athletes in the experimental group refused to complete the year-end survey. However, schools were of similar size with similar drug use patterns before drug testing, based on initial questionnaire data. Importantly, there were no differences in drug use among those who dropped out of the study (e.g., those who completed follow-up questionnaires) between experimental and control groups.

A policy of random drug testing surveillance appears to have significantly reduced recent drug use among adolescent athletes. Although athletes who were subject to drug testing had approximately one-fourth the 30-day illicit and one-third the 30-day use of the athletic enhancing substances at the end of the school year, the simultaneous changes in attitude and risk factors require caution in interpretation of the findings. A larger randomized study, extending over several years, is necessary to establish drug prevention efficacy.

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