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The Adolescents Training and Learning to Avoid Steroids Program: Preventing Drug Use and Promoting Health Behaviors

[Article]

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Abstract

Background: Use of alcohol and other illicit drugs by adolescent male athletes is a significant problem. Participation in sports may encourage use of drugs that enhance athletic performance, especially anabolic steroids (AS). Because, to our knowledge, no other intervention has successfully altered substance abuse by athletes, we developed and assessed the efficacy of a team-centered, sex-specific education program designed to reduce adolescent athletes' intentions to use and use of AS and alcohol and other illicit drugs.

Methods: We studied 31 high school football teams that comprised 3207 athletes in 3 successive annual cohorts (1994-1996). The intervention included interactive classroom and exercise training sessions given by peer educators and facilitated by coaches and strength trainers. Program content included discussion of sports nutrition, exercise alternatives to AS and sport supplements, and the effects of substance abuse in sports, drug refusal role-playing, and the creation of health promotion messages. Questionnaires assessing AS, the use of sport supplements and alcohol and other illicit drugs, and potential risk and protective factors were administered before and after the intervention (before and after the football season) and up to 1 year after the program.

Results: At season's end, intentions to use ($P<.05$) and actual AS use ($P<.04$) were significantly lower among students who participated in the study. Although AS reduction did not achieve significance at 1 year ($P<.08$), intentions to use AS remained lower ($P=.02$). Illicit drug use (marijuana, amphetamines, and narcotics) was reduced at 1 year, whether alcohol was included ($P=.04$) or excluded ($P=.02$) from the index. Other long-term effects included fewer students reporting drinking and driving ($P=.004$), less sport supplement use ($P=.009$), and improved nutrition behaviors ($P<.02$).

Conclusions: Use of alcohol and other illicit drugs and associated harmful activities can be prevented with a sex-specific, team-centered education. School athletic teams provide an optimal environment in which to provide drug prevention and health promotion education.

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PARTICIPATION IN school-sponsored sports can benefit adolescents. [1] However, it does not protect young male athletes from alcohol and other illicit drug (AOD) use. [2-4] Importantly, these athletes use anabolic steroids (AS) more frequently than their nonathlete peers, with a total of 4% to 12% of all athletes using AS at some point in their lives according to national and regional studies. [5-11] While illicit drug use in general decreased during 1998, AS use increased 12% and 28% among 12th and 8th graders, respectively. [9] The 1998 Monitoring the Future study [9] reported the highest rate of lifetime anabolic steroid use since initial assessments began in 1991. Again, during 1999, AS use increased "broadly across different regions and communities of different sizes," with a 17% increase among 8th graders and a 35% increase among 10th graders from 1998 levels. [10] However, for adolescent males, the increase in anabolic steroid use was even more dramatic, with use by 8th- and 10th-grade boys increasing by more than 56% and 47%, respectively, from 1998 to 1999. In the United States, the highest adolescent user group consists of high school football players. [5-8]

Anabolic steroids are testosterone derivatives, used by athletes to enhance muscle mass and strength. [12-13] Their use is associated with many significant adverse physical and emotional outcomes. [13-24] Moreover, adolescent AS users do not confine drug use to athletic-enhancing substances, often using a variety of illicit substances. [25]

Most school-based substance abuse prevention programs are directed at younger children, rather than older adolescents; unfortunately, the beneficial effects from these programs may not persist into high school. [26-28] Furthermore, no prior interventions have successfully addressed AS or other drug use in sports. [26, 28]

We conducted a randomized, controlled trial designed to address these shortcomings. This report describes results of 3 successive cohorts of adolescent football players, enrolled in the Adolescents Training and Learning to Avoid Steroids (ATLAS) program, designed to deter substance use in school-sponsored athletics.

SUBJECTS AND METHODS

STUDY DESIGN

Figure 1 provides a schematic of the study's cohort, assessments, and intervention timing. All cohorts were assessed before and after each football season (1994, 1995, and 1996, respectively). The initial intervention year included players from grades 9 through 12. Cohorts 2 and 3 included players from all of these grades, but mostly consisted of 9th- and 10th-grade students. One-year follow-up program effects were available for cohorts 1 and 2, and are combined in the long-term follow-up assessment. Cohorts were combined to increase statistical power to detect changes in lower prevalence behaviors such as AS use.

Figure 1. Adolescents Training and Learning to Avoid Steroids implementation timeline. P indicates preseason questionnaire; E, end-of-season questionnaire; and O, 1-year follow-up questionnaire.

RECRUITMENT AND FOLLOW-UP

Thirty-four high schools in the Portland metropolitan area agreed to participate and were matched in dyads, based on salient demographics including school size, family socioeconomic status, and the football team's prior win-loss record. After randomization but prior to student recruitment, 3 schools in the experimental group withdrew, owing to time commitment and curriculum control issues. Two of 3 unpaired control schools were rematched, with 1 randomly reassigned to the

experimental group, producing 15 schools in the experimental group and 16 in the control group.

This investigation was approved by the Institutional Review Board of the Oregon Health Sciences University. All athletes were approached for study inclusion. Students and parents provided written consent. Research staff administered confidential questionnaires at baseline (prior to the intervention), at season's end, and at long-term follow-up (school year's end for seniors and 1-year follow-up for returning players).

PREVENTION PROGRAM

Instruction

The program, integrated into team practice sessions, had 2 components: a classroom curriculum and weight-room skill training sessions. The 45-minute classroom activities were facilitated by coaching staff and/or surrogates. Approximately 60% of classroom curriculum was given in small student groups (6-8 students) by coach-selected volunteer team members who were trained as peer facilitators. Trainers selected by the authors taught the exercise sessions.

Experimental Group Intervention

The curriculum addressed normal adolescent physiology and potential effects of AS and AOD use in sports. Strength training and sports nutrition education were provided as alternatives to AS and sport supplement use. Athletes analyzed supplement claims, located advertisements for treatments of the adverse effects of AS treatments (eg, hair replacement, breast reduction surgery, and acne therapies) in bodybuilding magazines, created health promotion media messages, and practiced drug refusal through role-playing.

Two pocket-sized guides were distributed to participants in the experimental group. A sports nutrition guide recommended high-protein, high-carbohydrate, and low-fat food choices, with suggested meal plans. A weight-training booklet supplemented the exercise sessions and further described strength-training techniques. Parents received an expanded version of the sports nutrition guide.

Instructional materials were highly scripted to enhance program fidelity. Cohort 1 received 7 classroom and 7 weight-room sessions. Participants in cohorts 2 and 3 received the same content in a compressed, 8-session version (5 classroom and 3 weight-room sessions).

Implementor Training

Coaches in the experimental group participated in a single curriculum in-service. Coach-selected peer leaders were instructed in small groups during similar sessions.

Control Condition

Control students were provided with a commercially produced, anti-AS pamphlet [29] or similar handout, emphasizing the adverse effects of AS and benefits of a sports nutrition diet.

Questionnaires

Preintervention athletes in the experimental and control groups completed a 168-item self-report questionnaire, developed from national surveys and earlier research. [10, 30-31] Many individual items were grouped as constructs to assess theoretical risk and protective factors and proximal and distal program outcomes (Table 1). [30, 32] These construct assessments included a student's belief in coach tolerance to AS use, susceptibility of AS adverse effects, and knowledge of exercise, sport supplements, and the effects of AS and AOD, emphasizing the consequences of drugs and alcohol use on athletic performance. Distal outcomes included intent to use and actual AS use, use of alcohol and illicit drugs (marijuana, amphetamines, and narcotics), drinking and driving, sport supplement use, and healthy alternatives to substances that enhance athletic performance (eg, nutrition habits, such as a high-carbohydrate, relatively high-protein diet with less than 30% of the calories derived from fat and strength training self-efficacy). Follow-up questionnaires were similar to the preintervention surveys, without certain demographic characteristics and with some items not related to outcomes. Drug use questions were similar to Monitoring the Future surveys. [9] Most other questions were measured on 5- to 7-point agreement scales, used in prior research. [30-31]

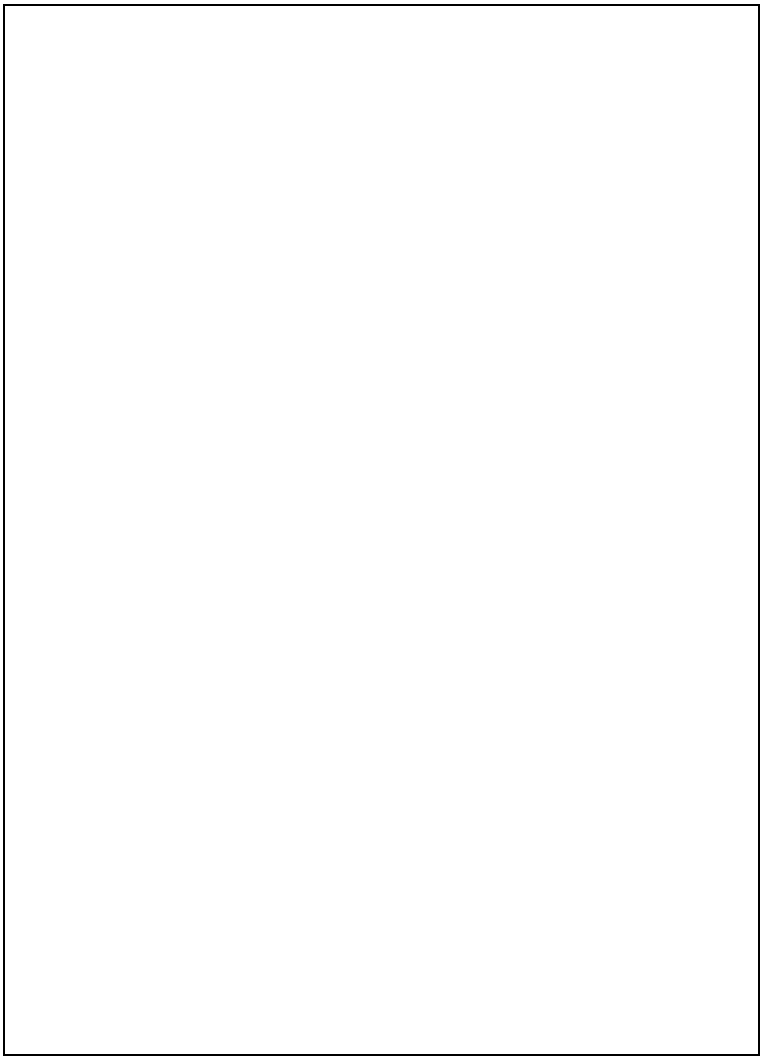

Table 1. Program Effects Preseason, End of Season, and at 1-Year Follow-up Analyzed by Subject and School*

STATISTICAL ANALYSIS□

Program effects were estimated with the conditional regression model using individuals and schools as units of analyses. Follow-up measures were used as the dependent variables, while preintervention measures and program exposure were independent variables. Program effects were the difference between control and experimental groups at follow-up, adjusted for the preintervention assessment. Ethnicity and father's education differed between groups at the baseline assessment. All analyses were repeated, with age, ethnicity, and father's education used as covariates in the regression model. School-level effects were analyzed because participants were clustered within each school's football team.

Whether the subject was a senior was a covariate in the long-term follow-up analyses to control for the difference in measurement time and the possible

differences between graduating and remaining students. For season's-end effects, all cohorts were combined, while cohorts 1 and 2 were combined for the long-term effects, as 1-year follow-up data are available only for these cohorts.

A variety of sport supplements, AS, alcohol, and each illicit drug's use were measured and analyzed by single items. The remainder of the individual questionnaire items were combined to represent constructs for the analyses, as is common in health research. [32] The questionnaire items used have shown substantial reliability. [33]

The program was designed as a primary prevention intervention to reduce the incidence of new AS users (ie, the number of athletes who began using AS after baseline assessments). Comparisons between experimental and control groups used logistic regression analysis. For school-level analysis, we assessed cumulative percentages of new users, examining effects with the conditional model using ordinary regression analysis. The same analyses were conducted on the cumulative index of new sport supplement use and drinking and driving behavior. The cumulative sport supplement index was a combination of various sport supplements (excluding vitamins and minerals). Differences in the experimental and control groups were incorporated in these analyses by weighting the frequencies of new users and nonusers among groups.

The intervention measured new and cumulative use of AOD, sport supplements, and drinking and driving behavior. We assessed an illicit drug index by calculating the sum of dichotomized responses (ever used vs never used) for marijuana, amphetamines, and narcotics. Because alcohol is not legal for adolescents, we included alcohol and illicit drugs as an AOD index in the analyses, and then assessed the estimated effects with the conditional model using ordinary regression analysis.

RESULTS□

SCHOOL AND SUBJECT RETENTION□

All schools were retained in the follow-up periods. Student attrition was expected from 3 sources: team withdrawal, school transfer, or study withdrawal. Only study withdrawal was potentially modifiable by investigators. A total of 3207 adolescent athletes were enrolled in the study and assessed at baseline. Because football rosters shrink during the first few weeks of school owing to dropouts (from quitting or injury), precise estimates of the total subject pool are not available. Coaches estimate that approximately 20% fail to complete the season. [31] Of those students assessed during the preseason, 78.5% (N=2516; 1371 in the control group and 1145 in the experimental group) were present at the season's end, the expected team attrition rate.

The 1-year follow-up retention rate was consistent with the annual retention rate in Portland Public Schools (71.6% for nongraduating students). We achieved a

comparable retention among cohorts 1 and 2, postseason to 1-year follow-up: 68.7% (N=1291; 700 in the control group and 591 in the experimental group), a rate similar to other school-based prevention studies. [34] The attrition rate among the experimental and control groups at the 1-year follow-up did not differ.

BASELINE CHARACTERISTICS□

Mean age for each cohort was between 15 to 16 years (3-cohort mean, 15 years 5 months). Table 2 shows demographics for subjects who took both the preseason questionnaire and the end-of-season questionnaire. Group differences were tested with *t* tests for the continuous variables and $[chi]^2$ tests for categorical variables. The experimental group had more African Americans ($P<.001$) and fewer whites ($P<.05$) than the control group. Parental education of the experimental group was lower than for the control group (father's education, $P<.001$; mother's education, $P<.01$).

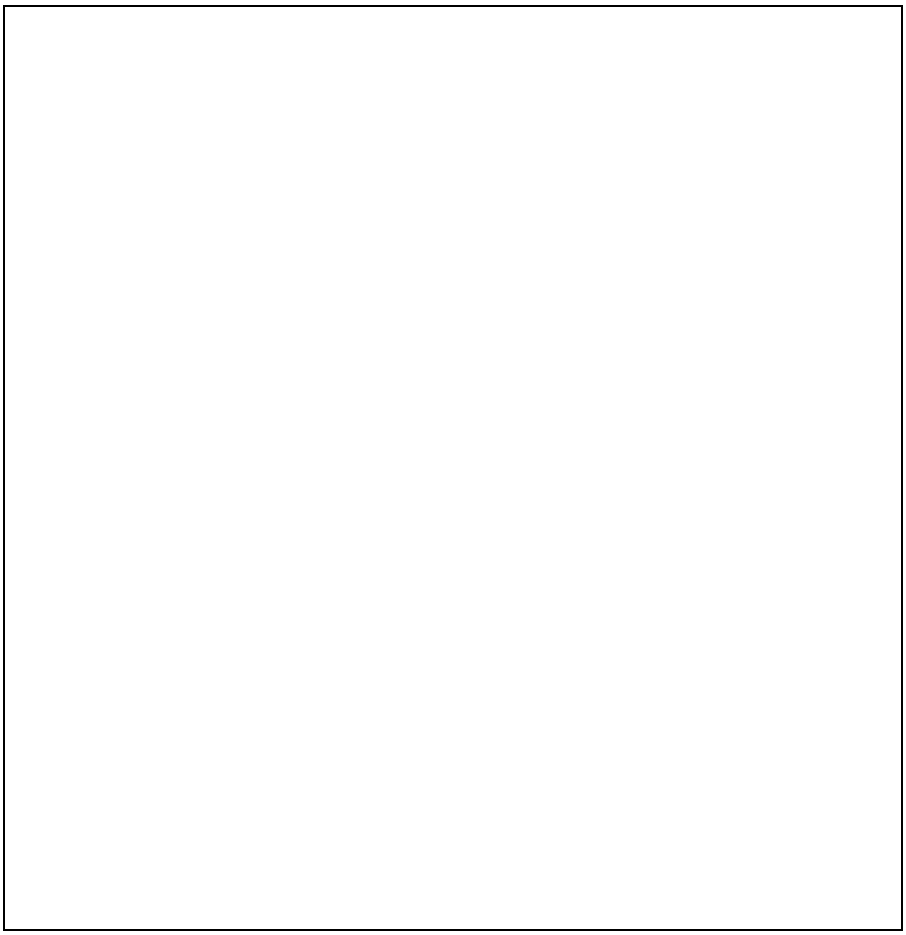

Table 2. Individual Comparison of Demographic Characteristics Between Experimental and Control Subjects Who Took Both the Preseason and the End-of-Season Questionnaires

Baseline equivalence was assessed for each construct. Individual-level, 2-tailed analyses indicate that subjects in the experimental group reported greater knowledge of AS effects ($P<.01$), higher normative AS use ($P<.05$), poorer nutrition behavior ($P<.01$), and lower strength-training self-efficacy ($P<.05$) compared with controls. School-level baselines found differences only in nutrition behavior ($P<.05$) and strength-training self-efficacy ($P<.01$). Outcomes were not altered when baseline differences, including age, were used as covariates.

PROGRAM EFFECTS

The analyses used 1-tailed significance for the program effects, justified by the positive findings detected in the pilot and cohort 1 findings. [30-31] Both school and subject-level analyses are shown in Table 1. In the text, we describe effects at the subject level, because school-level results were similar (90% long-term concordance).

KNOWLEDGE

Athletes in the experimental group showed improved knowledge of the effects of exercise and sport supplements at the season's end and on long-term follow-up (both, $P<.001$). Athletes in the experimental group had greater knowledge of AS and alcohol's effects at both follow-up periods (both, $P<.001$), and marijuana use at the season's end ($P<.001$) and at 1-year follow-up ($P<.02$).

ATTITUDES/BELIEFS

Subjects in the experimental group more strongly believed that AS has harmful effects and perceived greater susceptibility to their effects at both follow-up assessments (both, $P<.001$). Likewise, subjects in the experimental group were less likely to believe advertisements for sport supplements and positive AS use images at both assessments (both, $P<.001$).

INDIVIDUAL FACTORS

Although ATLAS-trained students reported higher self-esteem ($P<.02$) and less impulsivity ($P<.001$) at the season's end, students in the experimental group had greater confidence in their athletic abilities both at the season's end ($P=.003$) and at long-term follow-up ($P<.02$).

TEAM INFLUENCES

At both follow-up evaluations, athletes in the experimental group believed that their teammates were more reliable sources for information about drugs, nutrition, and exercise (both, $P<.001$). Athletes in the experimental group perceived their coach as less tolerant of AS use at both follow-up evaluations ($P<.001$ and $P<.02$, respectively). Self-reported ability to reject drug offers from peers (ie, resistance

skills) was greater in the experimental group than the control group at the season's end (*P*=.004) and long-term (*P*<.03).

NEW SPORT SUPPLEMENT USE□

New sport supplement use (excluding vitamins and minerals) among those in the experimental group was not lower than control subjects at the season's end, but was reduced significantly at 1-year follow-up (*P*=.009).

AS: INTENT TO USE AND NEW USE□

The athletes in the experimental group reported lower intent to use AS than the control group at the season's end (*P*<.05) and at 1 year (*P*<.03). At the end of the season, more new AS users (*P*<.04) were found in the control group (n=18) than in the experimental group (n=7). In the 2 cohorts available for long-term follow-up, 19 new users (cumulative from baseline) were found in the control group and 9 were found in the experimental group (*P*=.072).

AOD USE□

The index of AOD use (marijuana, amphetamines, and narcotics) was not lower in the experimental group at the season's end, but was lower among the experimental group at 1-year follow-up (*P*<.05). When alcohol was excluded from the index, use of illicit drugs remained lower (*P*<.03) at 1 year among the experimental group.

OTHER HEALTH BEHAVIORS□

New occurrences of drinking and driving were lower among the experimental group at 1 year (*P*=.004). Those in the experimental group reported improved nutrition behaviors compared with the controls at the season's end (*P*<.001) and at 1 year (*P*<.02) and reported enhanced strength-training self-efficacy at both follow-up periods (both, *P*<.001).

COMMENT□

This study substantiates the benefits of a sex-specific, sports team–centered approach to improve adolescent health risks and behaviors. [30-31] Program participants reported lower use of alcohol and illicit drugs (marijuana, amphetamines, and narcotics), and less occurrence of drinking and driving 1 year after the intervention. In addition, ATLAS is the first intervention to achieve a significant reduction in new AS use, with more than twice as many new AS users in the control group after the football season. Although twice as many new AS users were in the control group at the 1-year follow-up (n=19 vs n=9), this difference did not achieve statistical significance. However, durable reductions in

the intention to use AS (a likely predictor of future drug use [35]) of those in the experimental group remained lower at the 1-year follow-up.

Corroborating these program effects are improved nutrition behavior and less use of sport supplements. This latter finding may be important in deterring AS use, as sport supplements that claim athletic enhancement were highly correlated with performance-enhancing drug use in this study. Previous methods to reduce AS and other substance abuse in sports have relied on cognitive education and drug testing. [36-39] A knowledge-only AS education program improved understanding of adverse effects but did not alter intentions to use or actual use of anabolic steroids, [36] while an approach that emphasized only the harmful consequences of AS [37] had a rebound effect, generating more interest in those drugs. [40] Although the legality of drug testing adolescent athletes has been upheld by the courts, [41] no prospective, controlled studies substantiate the prevention efficacy of testing programs. [42]

The ATLAS program's format is based on social learning theory [43] and uses an established social unit (the sports team) to redirect the students' goal-directed behavior. [30-31] Sports nutrition and strength training for performance enhancement are stressed as healthy alternatives to AS use. With team-centered programming, content can be sex-specific and address the causes and risks of substance abuse unique to male adolescents. [44] Emphasizing the effect of alcohol and other drugs on immediate sport performance rather than long-term complications (eg, addiction and risks of disease) appeals to adolescents' focus on the present. The success of this intervention model is supported by the findings that ATLAS-trained athletes believed their teammates were more reliable sources of information about AS, drugs, nutrition, and strength training than control teammates, and coaches of the experimental group were perceived as more intolerant of AS use.

There are limitations to the investigation. Study power was limited as AS use was lower than expected. [6-8, 25, 45] Several factors may have contributed to this. Participation was voluntary, requiring active student and parental consent. Questionnaires were confidential but not anonymous; research staff (not school personnel or parents) could identify respondents through codes. Thus, some students who used or were considering using AS may have been reluctant to enroll. Alternatively, these students may have enrolled in the study but not admitted to drug use. For these reasons, we expected and observed a lower base rate of AS use than in anonymous, point prevalence surveys. [6, 8, 25, 45] Despite this, AS use was significantly less among students in the experimental group after the season, and intent to use, a predictor of future drug use [35] was significantly lower at both follow-up periods.

Curriculum time differed between the first and later cohorts, with a reduction in class contact hours. However, program content remained similar in scope. Furthermore, the team format allows reinforcement of classroom materials during

other team sessions so that curriculum time underestimates the effect of the intervention. Although this reduction could be detrimental to an intervention's efficacy, 26 substantial improvements were maintained. Also, despite small differences in age of the cohorts, outcomes, assessed as a covariate, were not age-related.

High school athletes are an important group for health promotion and AOD prevention. High school–sponsored athletic groups enroll approximately 50% of the entire student body at some point during the school year. 46 Importantly, athletes can be role models and opinion leaders for other students because of their elevated social status, 47-48 and have been used to facilitate drug prevention interventions. 48 While an athlete's drug use may lead others to initiate substance use, 49 their abstinence has a potential deterrent effect. 41

The ATLAS program demonstrates widespread and sustained 1-year drug prevention and health promotion effects for male adolescent athletes. Sex-specific, sports team–centered education is a new paradigm that can favorably influence adolescent behavior.

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Editor's Note: Back in July 1996, when the preliminary study was published, I stated that I'd be "eagerly awaiting the long-term outcomes." My eagerness for the intervention has faded, but that for the follow-up, large-study population is as strong as ever.—*Catherine D. DeAngelis, MD*

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