Prevention Science, Vol. 2, No. 1, 2001

Mediating Mechanisms in a Program to Reduce Intentions to Use Anabolic Steroids and Improve Exercise Self-Efficacy and Dietary Behavior

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This study investigated the mediating mechanisms responsible for the effects of a program designed to reduce intentions to use anabolic steroids, improve nutrition, and increase strength training self-efficacy. Fifteen of 31 high school football teams ($N = 1{,}506$ players at baseline) in Oregon and Washington were assigned to receive the intervention. The multicomponent program addressed the social influences promoting ergogenic drug use and engaging students in healthy nutrition and strength training alternative behaviors. Although the results differed across the three dependent variables, the program appeared to work by changing team norms. Unlike prevention of other drugs, changes in knowledge and perceived severity were mediators of program effects in this study.

KEY WORDS: adolescents; prevention; anabolic steroids; mediation analysis.

INTRODUCTION

The primary focus of prevention program evaluations is assessing change in outcome measures, such as drug use (Pentz *et al.*, 1989), exercise behavior (Marcus *et al.*, 1998), psychological symptoms (Wolchik *et al.*, 1993), or medical illness (Multiple Risk Factor Intervention Trial Research Group, 1990). Another important task of program evaluation is the investigation of the mediating mechanisms by which program effects are obtained. Typically prevention programs are designed to change mediating variables hypothesized to be related to the dependent variable. In drug prevention research, for example, it is useful to know if knowledge, social norms, resistance skills, or beliefs are responsible for an observed prevention program effect (Judd & Kenny, 1981; MacKinnon, 1994). These analyses, called mediation analyses, test whether the prevention program changed the mediator, which in turn changed the dependent variable, thereby providing tests of the theoretical basis of the intervention that are crucial for furthering the science of health behavior. Additionally, these new analyses yield practical information on the intervention's strengths and weaknesses allowing for the designing of more effective and efficient programs. As recently summarized in a review of physical activity interventions, "intervention research must more carefully focus on understanding mediating mechanisms" (Baranowski *et al.*, 1998, p. 294).

Mediation analysis has already provided an insight into the critical program ingredients for delaying or preventing drug use. Across the few studies that examined mediational processes, social influences have emerged as mediators of beneficial drug prevention effects (Botvin *et al.*, 1999; Donaldson *et al.*, 1994; Ellickson *et al.*, 1993; Hansen, 1992; Hansen *et al.*,

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1389-4986/01/0300-0015$19.50/1

1988). For example, social norms among friends and beliefs about the benefits of drug use mediated program effects on cigarette, alcohol, and marijuana use, 1 year after a social influences-based prevention program was delivered (MacKinnon *et al.*, 1991). Changes in antidrug attitudes and beliefs have also contributed to program effects on drug use among minority youth (Botvin *et al.*, 1994). Perceived prevalence and acceptability of drug use, but not resistance skills, were mediators of an alcohol prevention program (e.g., Donaldson *et al.*, 1994; Hansen & Graham, 1991). Overall, these studies suggest that passive social pressure, such as that conveyed through peer norms, was a primary pathway to prevent drug use. Knowledge, beliefs about the negative consequences of drug use, and resistance skills were not mediators in prior studies (Donaldson *et al.*, 1994; Hansen *et al.*, 1988; MacKinnon *et al.*, 1991; Sussman *et al.*, 1995).

The purpose of this paper was to identify the mediating mechanisms targeted by the Adolescents Training and Learning to Avoid Steroids (ATLAS) program that led to reduced intentions to use anabolic steroids, improved nutrition behaviors, and increased strength training self-efficacy. Mediation analysis was used to determine whether social norms mediates program effects on the ATLAS dependent variables as found in drug prevention studies. Alternatively, the mediators could differ for intention to use steroids, nutrition behavior, and strength training self-efficacy as these are not measures of drug use, and nutrition and strength training measure positive rather than negative health behaviors.

THE ATLAS PROGRAM

Anabolic androgenic steroids (AAS) are used to increase muscle growth and improve physical performance (Council on Scientific Affairs, 1990). About 1 million individuals have used AAS in the United States (Yesalis *et al.*, 1993). AAS use has spread to adolescents with 2.4% of twelfth graders reporting use in a recent national sample (Johnston *et al.*, 1995). AAS use can have negative physical and emotional consequences, including abnormal liver function and mood disorders (Haupt & Rovere, 1984). As a result, AAS has been denounced by many national and international organizations (American College of Sports Medicine, 1987). Although reduced AAS use is the ultimate long-term outcome of the ATLAS program, this report focuses on shorter-term outcomes of intentions to use AAS, nutrition behaviors, and strength training self-efficacy.

The ATLAS program was designed to prevent AAS use by reducing intentions to use AAS and teaching adolescents about two alternatives to enhance strength and physical performance—improved nutrition and appropriate strength training. It is assumed that changes in intentions lead to less AAS use as many other studies have found that intentions predict behavior (Fishbein & Azjen, 1975; Kim & Hunter, 1993). ATLAS was based on successful social–influences-based drug prevention programs on gateway drug use (Glynn, 1989) and prior experimental trials of AAS prevention (Bents *et al.*, 1990; Goldberg *et al.*, 1990, 1991).

Like most modern prevention programs, the ATLAS program was based on theories of behavior and observed empirical relationships between risk factors and anabolic steroid use, which provide the theoretical rationale for testing the possible mediators. Foremost was Social Learning Theory (Bandura, 1977). According to this theory, adolescent drug use is influenced by environmental influences (Ary *et al.*, 1993; Hawkins *et al.*, 1992). By observing peers, coaches, and parents, adolescents learn to use drugs and establish norms regarding drug use. As AAS are used for muscle growth and performance enhancement, anabolic steroid use was considered a goal-directed activity reinforced by peers, coaches, and other adults. To change the norms about drug use, to increase the awareness of the disapproval of drug use in the social environment, and improve self-efficacy skills to resist drug offers, the ATLAS program was led by the coaching staff and designated peer educators.

ATLAS was also based on the Health Belief Model (Janz & Becker, 1984). Adolescents' decision not to use AAS is determined by perceived susceptibility to and severity of the effects of AAS. Moreover, adolescents would choose the alternative health behaviors when they see the benefits and reduced barriers to the use of alternative health behaviors through teaching appropriate nutrition and strength training. As suggested by the Health Belief Model, the ATLAS program emphasized the harmful effects of AAS use and susceptibility to these negative effects. As parallel program components, the ATLAS program provided the participants with nutritional guidance and strength training for them to obtain similar effects of AAS use but in a healthy way.

Another theoretical frame of the ATLAS program was the Theory of Planned Behavior (Ajzen,

1991; Fishbein & Azjen, 1975). This theory postulates that behavioral intention, which is the most immediate predictor of AAS use, is determined by attitudes/beliefs regarding AAS use and its users, subjective norms of AAS use among peers, and perceived behavioral control to abstain from using AAS. The ATLAS program included several components to change norms, beliefs, and attitudes about AAS. The experimental group students discussed the issue of substance use in sports and reasons to use AAS, analyzed media advertisements on AAS effects, and developed an anti-AAS advertisement. In addition, the experimental group received classroom sessions designed to increase their understanding of alternatives to steroid use, including nutrition and strength training.

The effects of the ATLAS program on intention to use AAS, self-reported nutrition behavior, and strength training self-efficacy were reported elsewhere (Goldberg *et al.*, 1996). There were program effects on several potential mediators as well. In this paper, mediators refer to all constructs targeted by the ATLAS program. The purpose of this paper is to investigate which of these constructs actually mediated program effects. Participants exposed to the program had increased knowledge of the effects of AAS, perception that peers and team were reliable sources of information, confidence in ability to resist offers, negative attitudes toward AAS users, perceived severity of AAS effects and susceptibility to those effects, reasons endorsed for using AAS as well as reasons against using AAS, perceived athletic competence, and self-esteem. Program students also became less likely to believe that their coaches were tolerant of AAS use or to believe in media advertisements for alleged athletic-enhancing products.

The ATLAS program differs from the earlier drug prevention programs in several ways. First, ATLAS focused on AAS rather than tobacco, alcohol, or marijuana. Second, high school football players rather than junior high and middle school students were the study sample. Third, strength training and nutrition could be offered as alternatives to AAS. Typical drug prevention programs cannot offer such clear and comparable alternatives to tobacco or other drug use. Fourth, strength training sessions reinforced the proper training techniques learned in the classroom. Fifth, unlike many adolescent drug prevention programs that are presented in a health class setting, the ATLAS program was delivered in an athletic team setting with peers who share similar goals. Coaches, who spend considerable time with the players and thus potentially possess more influence than a health class teacher, led the classroom portion of the program and made explicit statements about their expectations for the players' behavior.

Every mediator targeted by the ATLAS program was expected to contribute to the success of the program. However, changes in social norms should be the primary mediator of program effects if the mediating mechanisms are similar to those found in other drug prevention research. Significant mediation effects of knowledge and beliefs about negative consequences may be expected in this study even though there is no consistent evidence for these constructs as mediators in previous drug prevention research. Knowledge may be a mediator of ATLAS program effects but not gateway drug use prevention because participants may lack knowledge of AAS effects whereas effects of tobacco and alcohol are well known. Similarly, the negative consequences of steroid use may be unknown, perhaps making changes in the perceived vulnerability to negative effects or the severity of those effects significant mediators of the ATLAS program.

METHODS

Participants

One thousand five hundred and six adolescent football players from 31 high schools in Oregon and Washington participated in this study. Football players were the focus of this study because they are at high risk for AAS. The average age was 15 years and 10 months. Of the total sample, 78.3% were White, 5.3% were African American, 3.3% were Asian, 2.7% were Hispanic, 0.8% were Native American, and 9.6% had a mixed ethnic heritage. The parents of the participants were well educated, with 69.3% of the mothers and 74.8% of the fathers having completed at least some college. Thirty-two percent of the parents were divorced. The median annual family income, as estimated by the players, was about $50,000.

Of the 1,506 football players that initially participated in the study, 81.4% ($n = 1226$) were present at posttest. Fewer experimental (75.8%) than control (86.3%) participants remained in the study, $z = 5.23$, $p < .001$. From pretest to 1-year follow-up, 57.7% ($n = 869$) of the sample was retained, and there was no differential attrition across groups at this measurement (57.5% in control schools and 58.0% in program schools; $z = .14$, *ns*).

All 31 schools measured at baseline were retained over the follow-up periods. The main sources

of student attrition were absence due to injury during the football season, quitting or getting dropped from the team, school transfer, or study withdrawal. Because the size of the football team changes during the first few weeks of school due to dropouts, precise estimates of the total participant pool are not available. Coaches estimate that approximately 20% fail to complete the football season. Of those students assessed at the baseline measure, 81.4% were measured at posttest, which is the expected team retention rate. At 1-year follow-up, the retention rate was consistent with annual student retention rates in Portland public schools, where 71.6% of students are retained from year to year. In our sample, of those who were assessed at posttest, 70.8% were measured at 1-year follow-up.

Design

Thirty-four schools were randomized to conditions after matching on win/loss records and socioeconomic status. Three schools in the experimental group dropped out prior to the intervention. One control school was reassigned to the program group, resulting in 15 experimental schools and 16 control schools.[7] Twenty-eight of the final 31 schools represent the original pairs that were matched on team records and SES and then randomized to conditions. As an incentive, all participating schools received $3,000 worth of weight room equipment.

The players were measured in late August 1994, when the football season started (pretest), in November 1994 near the end of the football season (posttest), and again in late August 1995 (1-year follow-up). Graduating seniors were assessed just prior to graduation in Spring 1995 (N Program = 94, N Control = 146) as they would not have been available for assessment in August. Their data were combined with the August 1995 data to comprise the 1-year follow-up assessment. Between pretest and posttest, the experimental schools received a 7-week, 14-session prevention program whereas the control schools received only a pamphlet about steroid use. No further intervention was given prior to the 1-year follow-up assessment. The ATLAS program encompassed a 7-session strength training segment and a 7-session classroom program (Goldberg *et al.*, 1996). The weight room sessions primarily targeted strength training self-efficacy, but also reinforced many of the lessons taught during the classroom sessions.

Measures

The mediators selected for the analysis, shown in Table 1, are a subset of the total number of mediators developed and measured in the ATLAS study. The 12 potential mediators selected for mediation analysis had at least three items forming the scale; had a coefficient alpha of at least .6 at each measurement; were measured at all three waves; and measured beliefs, knowledge, norms, or resistance skills, which were the important mediators according to the Social Learning Theory, the Health Belief Model, and the Theory of Planned Behavior. Beliefs measures were perceived severity of AAS use, perceived susceptibility to AAS effects, beliefs in media advertisements, reasons for using AAS, and reasons for not using AAS; knowledge measure was knowledge of AAS effects; norms measures were perceived coach tolerance of AAS use, perceived peer tolerance of AAS use, team as an information source, peers as an information source, and normative beliefs about AAS use; and the resistance skills measure was ability to turn down offers of drugs.

Mediation Analysis

The steps for testing mediation described in Baron and Kenny (1986) and MacKinnon and Dwyer (1993) were followed. Mediators with nonsignificant program effects or nonsignificant relationships with the outcome measure were unlikely to be significant mediators of program effects. There were instances, however, where the lack of program effects on certain mediators provided information about the program and its theoretical basis. Two of the mediators, perceived AAS norms and perceived peer tolerance of drug use, did not have clear program effects but were included in the analysis as these were important

[7]There was no significant difference between the experimental the control groups on several important demographic variables, whether or not we included the three schools that were originally assigned to the control groups. Analysis of the data without the one reassigned school led to virtually identical conclusions to those reported here. Also, when we examined the program implementation data based on the observations by the ATLAS staff, the one experimental school that was originally assigned to the control group was in the middle range of global ratings (1: low to 10: high): The average ratings were 4 for the classroom sessions and 5.5 for the weight room sessions. This school implemented six out of seven classroom sessions. Thus, it is unlikely that the original control school reassigned to the experimental group was different from the rest of the experimental schools.

Table 1. Constructs, Individual Items, and Cronbach's α Reliability Coefficients

Constructs and items	Cronbach's α		
	Baseline	Posttest	1-year follow-up
Intent to use AAS	.923	.921	.918
I intend to try to use anabolic steroids.			
I would be willing to use steroids to know how it feels.			
I am curious to try anabolic steroids.			
I would use anabolic steroids, if more of my teammates would start using them.			
I would use anabolic steroids, if more of my friends would start using them.			
Nutrition behaviors	.810	.809	.816
Over the last few months I have tried to improve my diet.			
I eat a diet that has no more than 30% calories from fat.			
I am aware of the calorie content of the food I eat.			
I set goals for my nutrition.			
I keep track of the calories I eat.			
I keep track of the protein I eat.			
I choose healthy food when I eat at a fast food restaurant.			
Strength training self-efficacy	.879	.902	.914
I know how to train with weights to become stronger.			
I know how to train with weights to get more power.			
I know how to train with weights to increase my endurance.			
I know the basics of a good diet to help build my muscles.			
In the last few months I have increased my maximum weight on the bench press.			
I know how to train with weights to get as strong and quick as possible.			
Knowledge of the effects of AAS	.849	.898	.915
Please mark any of the effects or benefits that you believe anabolic steroids can cause: more arguments and fights, improve physically, uncontrolled anger, increased acne on face and back, frequent urge to urinate, sexual problems, nosebleeds, breast development, testicles shrinking.			
Please mark whether or not you think these health problems can readily be caused by anabolic steroids: liver disease, heart disease, cancer, stunted growth, sterility, hearing problems, AIDS by sharing needles, death, baldness.			
Perceived coach tolerance of AAS use	.640	.764	.761
I have talked with at least one of my coaches about different ways to get stronger/faster instead of using AAS.			
On my team there are rules against using anabolic steroids.			
If I get caught using AAS, I would get in trouble with my coaches.			
Team as an information source	.758	.824	.823
Being on the football team has improved my health.			
Being on the football team teaches players about getting stronger.			
Being on the football team teaches players about eating healthy.			
Peers as an information source	.844	.882	.878
My team leaders help me learn about drug prevention.			
My team leaders help me learn about sports nutrition.			
My team leaders help me learn about weightlifting.			
Ability to turn down drug offers	.875	.887	.863
I would be comfortable turning down a friend who offered me anabolic steroids.			
I would be comfortable turning down a friend who offered me alcohol or drugs.			
I would be comfortable turning down a weightlifter who offered me anabolic steroids.			
I would be comfortable turning down a weightlifter who offered me alcohol or drugs.			
Perceived peer tolerance of drug use	.917	.913	.895
My teammates wouldn't care if I used the following: cigarettes, alcohol, marijuana, anabolic steroids, human growth hormone			
Normative beliefs about AAS use	.813	.802	.827
Out of every 100 high school football players at other schools, how many do you think have ever used anabolic steroids, even once?			
Out of every 100 high school football players at your school, how many do you think have ever used anabolic steroids, even once?			
Out of every 100 average male students at your school (not just athletes, but everyone), how many do you think have used anabolic steroids, even once?			

(*Continued*)

Table 1. (*Continued*)

Constructs and items	Cronbach's α		
	Baseline	Posttest	1-year follow-up
Perceived severity of AAS use	.820	.826	.839
The bad effects of anabolic steroids go away as soon as you stop using them.			
Only a few people who use anabolic steroids ever have any harmful or unpleasant side effects.			
Anabolic steroids are not dangerous if you use them only a few months each year.			
Perceived susceptibility to AAS effects	.704	.765	.752
If I were to use anabolic steroids, I wouldn't have any bad side effects.			
What are the chances that an average high school athlete would have serious health consequences as a result of regular anabolic steroid use?			
What are the chances that you personally would have serious health consequences as a result of regular anabolic steroid use?			
Beliefs in media advertisements	.746	.814	.805
A picture of a muscular person in an advertisement in a muscle magazine is proof enough that the product being advertised really works.			
If a magazine runs an advertisement for a product, they must have checked it out and found that the claims in the advertisement were true.			
I think that most products advertised in muscle magazines do what they claim to do.			
Reasons for using AAS	.865	.855	.872
If you were going to use anabolic steroids, why would you take them? Please mark all the reasons that are or were reasons why you would take steroids: increase in size or weight (to get bigger), get stronger, become a better athlete, improve my appearance for muscle definition, be more aggressive, increase chances of college sport scholarship, to get more praise from coach and trainer, players on my team were using them, my friends were using them.			
Reasons for not using AAS	.842	.886	.892
If you don't use steroids, why not? Mark all that apply: concern about possible health risk, afraid of becoming addicted, afraid of undesirable side effects, afraid of becoming aggressive or out of control, know a steroid user who had side effects, coaches disapprove of steroids, parents disapprove of steroids, friends and/or teammates disapprove, the drugs cost too much, steroids are too hard to get, afraid of being caught, friend/teammate got caught using steroids, not competing or working out anymore, because it is cheating.			

theoretical mediators. Mediation effects were examined at the individual level of analysis because the number of schools ($N = 31$) was small for the covariance structure analysis (Tanaka, 1982) at the school level. We also ran the analysis, using multilevel models (Krull & MacKinnon, 1999), and this led to the same conclusions described in the Results section. In most cases, the standard errors of the mediated effect were slightly higher in the multilevel analysis.

Separate multiple mediator models were estimated for posttest and 1-year follow-up. The parameters and standard errors of the model were estimated using covariance structure analysis (AMOS; Arbuckle & Wothke, 1999). First, the mediation effect for each individual potential mediator on each dependent variable was tested. Figure 1 shows an example of the single mediator model, where peers as an information source is the mediator and intention to use AAS is the outcome. The single mediator model shown in Fig. 1 included paths to describe the relationship between baseline and follow-up values of the mediator (b_1) and between baseline and follow-up values of the outcome measure (b_2). The path from the baseline mediator to the follow-up outcome measure was also included (b_3). Covariances among all the exogenous variables in the model (the program variable, the baseline mediator, and baseline outcome measure) were freely estimated as represented by the double-headed arrows. The direct effect, or nonmediated effect, of the program on the outcome was b_4. The program effect on the mediator was b_5, and the regression coefficient relating the mediator to the outcome measure was b_6. The mediated effect was equal to b_5b_6, and the standard error of the mediated effect

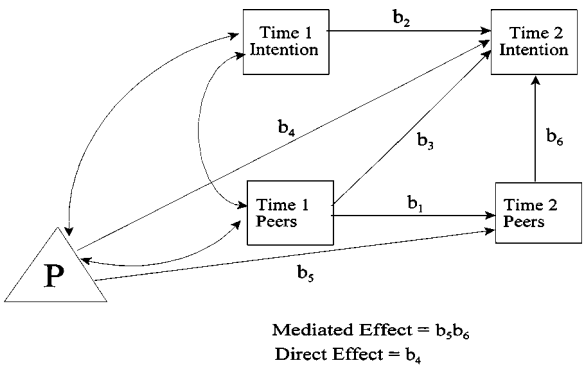

Fig. 1. Two wave mediation model with peers as an information source as the mediator and intention as the outcome variable. *Note:* P = ATLAS program, Intention = Intention to use AAS, Peers = Peers as an information source.

(Sobel, 1982) was equal to $\sqrt{b_5^2\sigma_{b_6}^2 + b_6^2\sigma_{b_5}^2}$. Simulation studies (MacKinnon *et al.*, 1995) suggest that the statistical test of mediation using this standard error is conservative (i.e., low statistical power). The sample size in this paper was sufficient to detect small effects. The conservative test of mediation is appropriate because the number of mediation tests in this report increases the likelihood of Type 1 errors.

In the multiple mediator model, all 12 mediators were included in the analysis thereby providing a simultaneous test of the mediators. Also, all three outcome variables were included in the model. All mediators were free to correlate at each wave. The model fit of the multiple mediator model was evaluated using χ^2 statistics, the root mean square error of approximation (RMSEA; Browne & Cudeck, 1993), the normed fit index (NFI; Bentler & Bonnett, 1980), and the comparative fit index (CFI; Bentler, 1990). Single and multiple mediator models results are both presented to provide a more complete picture of mediational processes. A significant effect in the single mediator model but not in the multiple mediator model is important because it suggests that the mediator's mechanism was present but was not statistically significant when adjusted for other mediators.

The estimates of parameters in the model were adjusted for attrition. All school-based prevention studies experience attrition when following participants over time (Hansen *et al.*, 1990). Attrition may be greater in the ATLAS study because retention in the study was contingent on remaining on the football team between measurements. Overall, approximately 15%–20% of the players on each team quit or are dropped from the football squad. The AMOS computer program was used to conduct a full information maximum likelihood estimation under the assumption that the missing data are missing at random (Arbuckle, 1996). Missing at random assumes that the reason for the missing data is either random or random after incorporating other variables measured in the study. Even when the missing at random condition is not satisfied, the parameter estimates and standard errors are generally better and never worse than estimates based on pairwise or listwise deletion (Graham *et al.*, 1994). Adjustment for missing data, using full information maximum likelihood implemented in the AMOS computer program, is currently considered one of the best methods to adjust for missing data and is now beginning to be more widely used (Hawkins *et al.*, 1997).

The percentage of the program effect that was attributable to each mediational pathway was assessed in this study. The percentage mediated is the proportion of the total effect of the program exposure on the outcome variable that is mediated by the mediating variable. The percentage mediated provides information on how much of the total program effect is attributable to each mediator. Following Alwin and Hauser (1975), absolute values of effects were used in the formula, which may slightly underestimate the percentage mediated. The numerator was the absolute value of the mediated effect. The denominator equaled the sum of the absolute values of direct and mediated effects.

RESULTS

Single Mediator Model

The mediated effect of each mediator for each dependent variable was tested first. For intention to use AAS, the significant mediators at posttest were knowledge of the effects of AAS, perceived coach tolerance of AAS use, team as an information source, ability to turn down drug offers, perceived severity of AAS effects, perceived susceptibility to the negative effects of AAS, beliefs in media advertisements, reasons for using AAS, and reasons for not using AAS. At the 1-year follow-up, these constructs remained significant mediators, except perceived coach tolerance of AAS use, ability to turn down drug offers, and reasons for not using AAS. Also, peers as an information source emerged as a significant mediator for intent to use AAS at the 1-year follow-up.

For nutrition behavior, knowledge of AAS effects, perceived coach tolerance of AAS use, peers as an information source, team as an information source, and reasons for not using AAS were the significant mediators at posttest. Among these, peers and team as information sources and perceived severity were significant mediators at the 1-year follow-up.

In the single mediator model for strength training self-efficacy, knowledge of AAS effects, perceived coach tolerance, peers and team as information sources, ability to turn down drug offers, perceived severity, perceived susceptibility, belief in media advertisements, and reasons for not using AAS significantly mediated the program effects at posttest. At the 1-year follow-up, all these constructs remained significant mediators except reasons for not using AAS.

Multiple Mediator and Multiple Outcome Model

The final models, which included all the 12 mediators and all three outcomes simultaneously, fit the data well both at posttest ($\chi^2(36) = 79.054$, $p = .000$; RMSEA = .028; NFI = .99; CFI = .99) and at the 1-year follow-up ($\chi^2(36) = 59.817$, $p = .008$; RMSEA = .021; NFI = .99; CFI = 1.00). The squared multiple correlation measure of explained variance was substantial at posttest and 1-year follow-up for intentions (.482 and .428), nutrition behavior (.399 and .307), and strength training self-efficacy (.458 and .477). The estimates of program effects on the mediator, mediator effects on the outcome, and mediated effects are reported in Table 2 for the intention outcome, Table 3 for nutrition outcome, and Table 4 for the strength training self-efficacy outcome.

Intention to Use Anabolic Steroids

At posttest, the program effects on intent to use AAS were significantly mediated by perceived severity of AAS effects (22% mediated), knowledge of the effects of AAS (15% mediated), ability to turn down offers of drugs (14% mediated), reasons for using AAS (12% mediated), perceived susceptibility to AAS effects (6% mediated), and reasons for not using AAS (5% mediated).[8] The mediated effect of reasons for using AAS was a counterproductive effect, meaning that the increase in reasons for using AAS actually led to greater intention to use AAS. At the 1-year follow-up, perceived severity of AAS effects (25% mediated) and reasons for using AAS (15% mediated) were significant mediators with the mediated effect of reasons for using AAS a counterproductive effect.

Nutrition Behaviors

At both posttest and 1-year follow-up, peers as an information source (22% and 31% mediated at posttest and 1-year follow-up, respectively), team as an information source (14% and 8% mediated at posttest and 1-year follow-up, respectively), and beliefs in media advertisements (9% and 14% mediated at posttest and 1-year follow-up, respectively) significantly mediated the program effects on nutrition behaviors. The mediated effect of beliefs in media advertisements was a counterproductive effect.

Strength Training Self-Efficacy

At posttest, team (23% mediated) and peers (23% mediated) as information sources, perceived coach tolerance (8% mediated), perceived severity of AAS effects (8% mediated), knowledge of AAS effects (7% mediated), ability to turn down the drug offers (3% mediated), and perceived susceptibility to negative effects of AAS (2% mediated) were significant mediators. At the 1-year follow-up, the mediated effects of peers (21% mediated) and team (20% mediated) as information sources and perceived severity of AAS effects (10% mediated) remained significant. Another construct, belief in media advertisements (10% mediated) was a significant mediator at the 1-year follow-up.

DISCUSSION

The ATLAS prevention program was designed to reduce intentions to use AAS and to improve diet

[8]The percentage mediated is the mediated effect divided by the total effect. For example, the absolute value of the mediated effect of perceived severity of AAS effects on AAS intention was .074 at posttest as in Table 2. The total program effect on AAS intention was calculated by adding all the absolute values of mediated effects of 12 potential mediators and the direct effect, .015, which summed up to .341. The percentage mediated by the perceived severity mediator was 22% (.074 divided by .341).

Table 2. Program Effects on Mediators, Mediator Effects on Intention to Use AAS, Mediated Effects, and Standard Errors of Estimates in the Multiple Mediator and Multiple Outcome Model

	Posttest			1-year follow-up		
Mediator	Program effect on mediator[a] (*SE*)	Mediator effect on intention[b] (*SE*)	Mediated effect[c] (*SE*)	Program effect on mediator[a] (*SE*)	Mediator effect on intention[b] (*SE*)	Mediated effect[c] (*SE*)
Knowledge of the effects of AAS	2.437 (.231)****	−.021 (.006)****	−.051 (.015)****	1.534 (.306)****	.012 (.007)	.018 (.011)
Perceived coach tolerance of AAS use	−.374 (.068)****	−.024 (.023)	.009 (.009)	−.161 (.086)*	.046 (.028)	−.007 (.006)
Team as an information source	.559 (.058)****	−.025 (.027)	−.014 (.015)	.229 (.072)***	−.017 (.034)	−.004 (.008)
Peers as an information source	1.084 (.081)****	.027 (.018)	.029 (.020)	.648 (.102)****	−.006 (.023)	−.004 (.015)
Ability to turn down offers of drugs	.283 (.068)****	−.168 (.023)****	−.048 (.013)****	.144 (.084)*	−.176 (.027)****	−.025 (.015)*
Perceived peer tolerance of drug use	−.169 (.095)*	.030 (.016)*	−.005 (.004)	.048 (.121)	.042 (.018)**	.002 (.005)
Normative beliefs about AAS use	−.122 (.079)	.029 (.018)	−.004 (.003)	−.007 (.100)	.069 (.022)***	−.0005 (.007)
Perceived severity of AAS use	.471 (.063)****	−.157 (.026)****	−.074 (.016)****	.269 (.079)****	−.259 (.032)****	−.070 (.022)***
Perceived susceptibility to the effects of AAS	.435 (.109)****	−.050 (.014)****	−.022 (.008)***	.278 (.131)**	−.054 (.019)***	−.015 (.009)*
Beliefs in media advertisements	−.588 (.065)****	.021 (.024)	−.012 (.014)	−.425 (.081)****	.007 (.029)	−.003 (.012)
Reasons for using AAS	.543 (.106)****	.078 (.013)****	.042 (.011)****	.480 (.123)****	.089 (.018)****	.043 (.014)***
Reasons for not using AAS	.979 (.204)****	−.016 (.007)**	−.016 (.008)**	−.001 (.262)	−.031 (.008)****	.00003 (.008)

Note. The direct effects of program exposure on intention outcome were .015 (.057) at posttest and −.093 (.067) at 1-year follow-up. The direct effect is the effect of the program on the outcome variable after adjusting for all mediators (b_4 in Fig. 1).

[a]The program effect on mediator is the path coefficient of the mediator on the program at the posttest (b_5 in Fig. 1).

[b]The mediator effect on outcome is the path coefficient of the outcome on the mediator at the posttest (b_6 in Fig. 1).

[c]The mediated effect is the product of the program effect on mediator and the mediator effect on outcome.

*$p < .10$. **$p < .05$. ***$p < .01$. ****$p < .001$, two-tailed.

and strength training self-efficacy by changing specific mediating variables including knowledge, norms, resistance skills, and beliefs. There was evidence that the program successfully changed many but not all of the mediators targeted by the ATLAS program. There were no significant program or mediated effects on peer tolerance of drugs and perceived prevalence norms suggesting that the program did not affect these mediators. Chen (1990) calls this lack of a program effect on the mediator a failure of the action-theory, the theory that links the program components to changes in the mediators. Most other variables that were not mediators in this report reflect a failure of the conceptual theory, the theory that links the mediators to the outcome measure. Given that peer tolerance and perceived norms had sufficient psychometric properties, the results suggest that the ATLAS program was not successful in changing these norm measures.

There was evidence that four constructs were mediators of all three outcomes in the single mediator models at posttest. Increased perception of the team as an information source and perceptions of coach's tolerance of AAS use suggest that changes in team and coach norms were important mechanisms in obtaining program effects on the outcomes. The other mediators of all three outcomes were knowledge of the effects of AAS and reasons against using AAS. Only three mediators, team and peers as information sources and perceived severity, were significant mediators for all three dependent variables at the 1-year follow-up.

Table 3. Program Effects on Mediators, Mediator Effects on Nutrition, Mediated Effects, and Standard Errors of Estimates in the Multiple Mediator and Multiple Outcome Model

	Posttest			1-year follow-up		
Mediator	Program effect on mediator[a] (*SE*)	Mediator effect on Nutrition[b] (*SE*)	Mediated effect[c] (*SE*)	Program effect on mediator[a] (*SE*)	Mediator effect on Nutrition[b] (*SE*)	Mediated effect[c] (*SE*)
Knowledge of the effects of AAS	2.437 (.231)****	.007 (.006)	.017 (.015)	1.534 (.306)****	−.006 (.008)	−.009 (.012)
Perceived coach tolerance of AAS use	−.374 (.068)****	.012 (.024)	−.004 (.009)	−.161 (.086)*	.002 (.030)	−.0003 (.005)
Team as an information source	.559 (.058)****	.143 (.027)****	.080 (.017)****	.229 (.072)***	.090 (.036)**	.021 (.010)**
Peers as an information source	1.084 (.081)****	.119 (.019)****	.129 (.023)****	.648 (.102)****	.130 (.024)****	.084 (.020)****
Ability to turn down offers of drugs	.283 (.068)****	.014 (.023)	.004 (.007)	.144 (.084)*	.018 (.029)	.003 (.004)
Perceived peer tolerance of drug use	−.169 (.095)*	.021 (.016)	−.004 (.003)	.048 (.121)	−.009 (.019)	−.0004 (.001)
Normative beliefs about AAS use	−.122 (.079)	−.012 (.019)	.001 (.003)	−.007 (.100)	.024 (.023)	−.0002 (.002)
Perceived severity of AAS use	.471 (.063)****	.007 (.026)	.003 (.012)	.269 (.079)****	.072 (.034)**	.019 (.011)*
Perceived susceptibility to the effects of AAS	.435 (.109)****	−.006 (.014)	−.003 (.006)	.278 (.131)**	−.029 (.019)	−.008 (.007)
Beliefs in media advertisements	−.588 (.065)****	.089 (.024)****	−.052 (.015)****	−.425 (.081)****	.091 (.030)***	−.039 (.015)***
Reasons for using AAS	.543 (.106)****	.016 (.014)	.009 (.008)	.480 (.123)****	−.018 (.018)	−.009 (.009)
Reasons for not using AAS	.979 (.204)****	.010 (.007)	.010 (.007)	−.001 (.262)	−.010 (.009)	.00001 (.003)

Note. The direct effects of program exposure on nutrition outcome were .267 (.058)**** at posttest and .079 (.070) at 1-year follow-up. The direct effect is the effect of the program on the outcome variable after adjusting for all mediators (b_4 in Fig. 1).

[a]The program effect on mediator is the path coefficient of the mediator on the program at the posttest (b_5 in Fig. 1).

[b]The mediator effect on outcome is the path coefficient of the outcome on the mediator at the posttest (b_6 in Fig. 1).

[c]The mediated effect is the product of the program effect on mediator and the mediator effect on outcome.

*$p < .10$. **$p < .05$. ***$p < .01$. ****$p < .001$, two-tailed.

Although there were many significant mediators in the single mediation models for both intent to use AAS and strength training self-efficacy, there were fewer mediators for these dependent variables when all 12 mediators and all three outcomes were included simultaneously in the models. Perceived severity was the most powerful mediator for program effects on intentions to use AAS. The ATLAS program successfully increased the awareness of the negative effects of AAS use and this appears to have reduced intention to use AAS. The team and peers as an information source measures were the primary mediators for program effects on strength training self-efficacy. These results are sensible because successful learning about strength training includes considerable peer and team interaction. The prevention program fostered discussion of effective strength training and thus changed team norms about AAS use, which in turn led to improved strength training self-efficacy. Perceived severity of AAS effects was also a significant mediator of strength training self-efficacy, suggesting that the increased awareness of the severe negative effects of AAS led to improved strength training, an alternative way to enhance athletic performance.

There were fewer mediators of program effects on nutrition behaviors. Three out of 12 possible mediators were significant at posttest and at the 1-year follow-up. At both posttest assessments and in both the single mediator and the multiple mediator models, perceptions of team and peers as information sources were significant mediators. The reduced number of significant mediators for the nutrition dependent

Table 4. Program Effects on Mediators, Mediator Effects on Strength Training Self-Efficacy, Mediated Effects, and Standard Errors of Estimates in the Multiple Mediator and Multiple Outcome Model

	Posttest			1-year follow-up		
Mediator	Program effect on mediator[a] (*SE*)	Mediator effect on efficacy[b] (*SE*)	Mediated effect[c] (*SE*)	Program effect on mediator[a] (*SE*)	Mediator effect on efficacy[b] (*SE*)	Mediated effect[c] (*SE*)
Knowledge of the effects of AAS	2.437 (.231)****	.017 (.005)***	.041 (.013)***	1.534 (.306)****	.013 (.007)*	.020 (.011)*
Perceived coach tolerance of AAS use	−.374 (.068)****	−.137 (.022)****	.051 (.012)****	−.161 (.086)*	−.088 (.025)****	.014 (.009)
Team as an information source	.559 (.058)****	.260 (.025)****	.145 (.021)****	.229 (.072)***	.297 (.031)****	.068 (.023)***
Peers as an information source	1.084 (.081)****	.129 (.017)****	.140 (.021)****	.648 (.102)****	.112 (.020)****	.073 (.017)****
Ability to turn down offers of drugs	.283 (.068)****	.074 (.021)****	.021 (.008)***	.144 (.084)*	.072 (.025)***	.010 (.007)
Perceived peer tolerance of drug use	−.169 (.095)*	−.009 (.015)	.002 (.003)	.048 (.121)	.034 (.016)**	.002 (.004)
Normative beliefs about AAS use	−.122 (.079)	.040 (.017)**	−.005 (.004)	−.007 (.100)	.001 (.020)	−.00001 (.0002)
Perceived severity of AAS use	.471 (.063)****	.109 (.024)****	.051 (.013)****	.269 (.079)****	.121 (.029)****	.033 (.012)***
Perceived susceptibility to the effects of AAS	.435 (.109)****	.032 (.013)**	.014 (.007)**	.278 (.131)**	−.042 (.017)**	−.012 (.007)*
Beliefs in media advertisements	−.588 (.065)****	−.010 (.022)	.006 (.013)	−.425 (.081)****	−.081 (.026)***	.034 (.013)***
Reasons for using AAS	.543 (.106)****	.027 (.013)**	.015 (.008)*	.480 (.123)****	.003 (.016)	.001 (.008)
Reasons for not using AAS	.979 (.204)****	−.001 (.007)	−.001 (.007)	−.001 (.262)	.010 (.008)	−.00001 (.003)

Note. The direct effects or program exposure on strength training outcome were −.128 (.053)** at posttest and −.074 (.061) at 1-year follow-up. The direct effect is the effect of the program on the outcome variable after adjusting for all mediators (b_4 in Fig. 1).

[a]The program effect on mediator is the path coefficient of the mediator on the program at the posttest (b_5 in Fig. 1)

[b]The mediator effect on outcome is the path coefficient of the outcome on the mediator at the posttest (b_6 in Fig. 1)

[c]The mediated effect is the product of the program effect on mediator and the mediator effect on outcome.

* $p < .10$. ** $p < .05$. *** $p < .01$. **** $p < .001$, two-tailed.

variable may be due to the tenuous theoretical link between changes in mediators more closely related to AAS use and changes in nutrition behavior. For example, program effects on ability to turn down drug offers are unlikely to lead to changes in nutrition behavior. The results suggest that the ATLAS program promoted discussion about nutrition and increased perception that the team norm favored proper nutrition, which led to improved nutrition behavior.

Reasons to use AAS was the exception to the uniformly beneficial effects of most mediators on intentions to use AAS. At both posttest and the 1-year follow-up, the ATLAS program increased the number of reasons for using AAS, which in turn increased intentions to use AAS. This counterproductive mediation effect was unanticipated but not surprising, given that the program included discussion of the benefits and limitations of AAS use in order to be credible with high school football players. The results of the mediation analysis suggest that the program may be improved with more focus on the risks of using AAS and less information on the benefits of AAS use.

Beliefs about media advertisements had a counterproductive mediation effect for the nutrition dependent variable. Several components of the ATLAS program were designed to reduce belief in the media, especially magazine advertisements for strength and growth enhancing compounds. It appears that participants did indeed become less likely to believe media advertisements, but this, in turn, led to poorer nutrition behavior, perhaps because the participants paid less attention to accurate health and nutrition

advice coming from the media. The ATLAS program could be improved with more attention to the separation of valuable versus coercive advertisement for strength and health promotion.

There are several limitations of this study. The data were analyzed at the individual level of analysis ignoring the clustering of individuals in schools. We did this because the theory regarding the program is based at this level and there were only 31 football teams. Mediated effects tested with bootstrapped standard errors, which may incorporate changes in variance due to clustering within schools, and program effects estimated using hierarchical regression models that include nesting of students in schools do not differ appreciably from the effects reported here. Another limitation of our study is that the data for this project are based on self-report and may be susceptible to reporting bias, although studies of self-report measures such as those used in this study generally find them to be valid (Rouse *et al.*, 1985). It would be difficult to explain these effects as due to reporting bias because it would not clearly explain why there were program effects and mediating effects on some but not all variables. A final limitation is that the conclusions are based on the data 1-year after the intervention was delivered. Mediators of longer-term effects may differ from those observed at 1-year follow-up. Similarly, other potential mediators, such as social competence, may be important but were not measured because of space and other limitations in the data collection.

The experimental nature of the design increases the validity of the conclusions reported. It is possible, however, that the direction of causality between the mediator and the outcome may be incorrect, that is, the outcome may change the mediator rather than the mediator changing the outcome as assumed in this research. Similarly, correlations were used to model the relationship among multiple mediators, which likely simplifies more complicated relationships among the mediators. It is reassuring that not all proposed mediators were significant mediators of the program effect, which provides evidence for the specificity of the effects. Nevertheless, ideally another experiment would be conducted, which contrasted different hypotheses regarding the mediation effects, for example, programs that focus on either social norms or perceptions of severity as the critical mediator.

The purpose of this study was to examine whether the constructs targeted in a social–influence-based prevention program were mediators of program effects on intentions to use AAS, nutrition behavior, and strength training self-efficacy. The results generally favored the social influence explanation, in that the extent to which the players reported that they perceived their team as a good information source led to the program effects. There was also evidence that the perceived severity of AAS use and knowledge of AAS effects were important mediators of ATLAS program effects on intention to use AAS. This finding is interesting because knowledge and beliefs about risks are typically not important predictors of health behavior in general (Janz & Becker, 1984) and are not usually identified as significant mediators in other drug prevention studies (Donaldson *et al.*, 1994; MacKinnon *et al.*, 1991). One explanation is that the effects of AAS are relatively unknown, making the potential impact of a program to teach this information much greater than that of a program targeting an area where risks are already well-known (e.g. smoking, cancer screening). Overall, this study validates changing social norms as an important focus of health promotion and disease prevention programs. It is also clear, however, that other mediators such as beliefs may play critical roles in successful programs. Finally, changing some mediators may actually lead to counterproductive effects illustrating that careful thought is required in selecting mediating mechanisms forming the basis of a prevention program.

ACKNOWLEDGMENTS

This research was supported by the National Institute on Drug Abuse grants (DA-07356 and DA-09757-04). We also thank the coaches, administrators, and especially the players who participated in this study.

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