*Pediatric Exercise Science*, 2004, 16, 250-264


# Predictors of Dietary Supplement Use Among Adolescent Athletes

R. Todd Bartee, Burke Grandjean, Michael S. Dunn, Michael A. Perko, James M. Eddy, and Min Qi Wang

This study sought to predict the use of dietary supplements marketed to enhance athletic performance among 1,737 adolescent athletes. An anonymous, paper-and-pencil, self-report survey was administered to the participants. Grade level, participation in multiple sports, and scales representing attitudes, subjective norms, and intention were all significant predictors of current dietary supplement use. The results of this study allow for the development of more appropriate prevention and intervention strategies that can target specific groups of adolescent athletes. The authors recommend that attitudes of adolescent athletes be addressed in interventions and that salient others be included in program planning.

## Introduction

The popularity of sports supplements and the possible adverse effects of their consumption have focused the attention of health professionals and researchers on the use of these products. Sports supplements accounted for $1.42 billion in sales in the U.S. in 1999, 9% of the $16-billion total U.S. dietary-supplement market. Creatine led the way in the muscle-building category with sales of approximately $230 million in that year (1).

Marketing claims for sports supplements generally lack consistent double-blind animal and human studies showing either performance gains or freedom from adverse side effects and long-term health consequences (3,14,30). Despite the growing scientific and medical literature on the subject, few studies have investigated factors that predict their use. Research has examined the influence of friends, parents, trainers, and coaches in athletes' perceptions of these products

Bartee is with the Division of Kinesiology and Health, University of Wyoming, Laramie, WY 82071-3196. Grandjean is with the Dept. of Sociology, University of Wyoming, Laramie, WY 82071. Dunn is with the Dept. of Public Health, East Tennessee State University, Johnson City, TN 37614-0674. Perko is with the Dept. of Health Studies, University of Alabama, Tuscaloosa, AL 35481-0311. Eddy is with the Health and Safety Division, Dept. of Health and Kinesiology, Texas A & M University, College Station, TX 77843-4243. Wang is with the Dept. of Public & Community Health, 2373 Health and Human Perf. Bldg., University of Maryland, College Park, MD 20742-2611.

(6,19,24,25,27). One study found that attitudes and norms predict the intention to use sports enhancement supplements (7). The present authors, however, know of no previous work that has systematically modeled the actual use of sports supplements marketed to enhance performance from the demographic characteristics and self-reported attitudes, norms, and intentions of high school athletes.

As in studies of intended use (6,7), the term *sports supplement* is defined here as dietary supplements marketed as enhancing athletic performance (such as creatine, chromium picolinate, Hot Stuff, and HMB). By contrast, until recently most studies of dietary supplements focused on vitamin/mineral products. Sobal and Marquart (26) conducted an extensive review of the literature and found that 47% of high school athletes reported using vitamin and mineral supplements. Prevalence of sports supplements, as defined in this paper, has been reported as being between 4.3% (25) and 31% (27).

Although the reported prevalence of sports supplements is lower than that of vitamin and mineral supplements, the potential negative effects are much greater. Because of legislative maneuvering, the Food and Drug Administration can provide only minimal safeguards and currently acts *ex post facto* in an effort to protect the health of consumers who purchase these products. Since the passage of the Dietary Supplement and Health Education Act (5), no federal agency tests nor regulates dietary supplement products. Regrettably, major illness and death has been reported in association with use of sports enhancement supplements (13,28).

Why would young athletes take products and substances that could negatively affect their health and, therefore, their athletic performance? Perhaps because they believe that they are safe and effective (18,23). More specifically, researchers have found that young athletes hold many expectations related to effectiveness of sports supplements, with the most popular being that they will build muscle, increase weight, and improve sports performance (18,19,20,23,25,27). These beliefs could be because of advertising ploys, erroneous claims, and misinformation about nutritional supplements for which the supplement manufacturers are responsible (4,10,12,15,16).

Friends might play a key role in athletes' normative expectations. Friends have been reported as the most likely sources of information on sports supplements (24,25). Friends, teammates, and coaches were found most likely to influence high school football players to take sports supplements in one study (27), whereas, in a study of adolescent athletes participating in a number of sports, participants reported that (in contrasting parents, athletic trainers, and coaches) it was parents who were most influential for females to take sports supplements, and it was athletic trainers for males (6).

Another study found that parents were most likely to discourage the use of creatine among adolescent athletes. Approximately one-quarter (26%) of the participants reported that their coaches encouraged its use, and 36% said coaches discouraged it. Friends were reported to be the most likely source of encouragement for creatine use (19).

A study based on the Theory of Reasoned Action found that attitude predicted the intention to use sports enhancement supplements better than did subjective norms (7). The present study adopts the same theoretical perspective and data collection instrument, but extends the earlier work to consider the effects of attitudes, subjective norms, and intentions on the actual use of sports supplements, as reported by athletes.

## Methods

### *Study Sample*

This is a secondary data analysis of data collected by the Health Sciences Department at the University of Alabama (8). Teachers from nine suburban schools in a large metropolitan area in the southern U.S. were asked to administer a self-report survey to their students. All students in each class surveyed were eligible to participate, but many of the items analyzed here are only relevant to student athletes. Therefore, the study sample is limited to 1,737 students (age 14–19 years and enrolled in grades 9–12). Demographics of the sample are summarized in Table 1.

**Table 1 Percentage of Participants Who Use Dietary Supplements Marketed as Nutritional Ergogenic Aids by Demographics**

| Demographic variable | *n* | % of sample | % of sample who use |
|---|---|---|---|
| Sex (*N* = 1,735) | | | |
| male | 1,014 | 58.4 | 29.3 |
| female | 721 | 41.5 | 18.0 |
| unknown[a] | 2 | .1 | — |
| Grade (*N* = 1,737) | | | |
| 9 | 414 | 23.8 | 20.6 |
| 10 | 533 | 30.7 | 21.6 |
| 11 | 458 | 26.4 | 28.4 |
| 12 | 332 | 19.1 | 29.0 |
| Ethnicity (*N* = 1,729) | | | |
| White | 1,425 | 82.0 | 24.3 |
| African American | 146 | 8.4 | 22.2 |
| other | 158 | 9.1 | 29.6 |
| unknown[a] | 8 | .5 | — |
| Age (*N* = 1,737) | | | |
| 14 | 166 | 9.6 | 17.7 |
| 15 | 457 | 26.3 | 21.0 |
| 16 | 494 | 28.4 | 20.1 |
| 17 | 391 | 22.5 | 34.1 |
| 18 | 206 | 11.9 | 28.6 |
| 19 | 23 | 1.3 | 43.5 |
| Number of sports participated in (*N* = 1,737) | | | |
| one | 1,159 | 66.7 | 21.1 |
| two | 427 | 4.6 | 32.5 |
| three to six | 151 | 8.7 | 29.1 |

*Note*. The category "other" of ethnicity includes Native American, Asian, Hispanic, and all else.
[a]Unkown = those who failed to complete that item.

### *Data Collection*

Data collection took place during the winter and spring of 1999. The Institutional Review Board at the home institution of the original researchers granted approval for administration of the survey. Before administration of the survey, a consent form was sent home for parents or guardians and students to sign and return to the teacher. Only students who returned completed consent forms were allowed to complete the questionnaire. Those students who did not return a consent form or chose not to participate in the study remained in the classroom while other students completed the survey. Information is not available from the original researchers on the proportion of students who returned completed consent forms, but among those who did, the response rate was over 90%.

Teachers were responsible for administering the survey to their students. Each teacher was instructed to administer the survey in a standardized manner consistent with the guidelines provided. The teacher remained in the classroom; students returned their surveys to a sealed box after completion. Confidentiality was further protected by instructing students not to put their names on the survey.

### *Instrumentation*

The Survey to Predict Adolescent Athletes' Dietary Supplement Use (SPAADSU) was used to collect the data (22). This instrument had been pilot tested with adolescent athletes to determine item discrimination and internal consistency and was shown to have high reliability: Cronbach's alpha = .94 (22). The instrument defined dietary supplements as products such as creatine, chromium picolinate, Hot Stuff, HMB, and andro. This definition used terms that focus groups with adolescent athletes had identified as most readily recognized (22); it expressly did not include general vitamin and mineral supplements, such as vitamin C or multivitamins.

The SPAADSU, based on the Theory of Reasoned Action (9), consists of 44 items. Eight items measure standard demographics, athletic and recreational participation, and dietary supplement use. Attitude toward dietary supplement use was measured with a 10-item scale and assessed the adolescents' positive or negative evaluation of engaging in the behavior (alpha = .91). The subjective norms scale included 13 items assessing the adolescents' perception of social pressure to engage in supplement use and their motivation to comply with influential others (alpha = .89). Intention was measured on a 13-item scale and assessed the adolescents' willingness to take dietary supplements in a number of situations (alpha = .89). Composite scores were calculated for attitude, subjective norms, and intention variables. The underlying items were all scored from 1 to 5, and the scales were assigned the same metric by averaging the constituent items. Thus, on each scale, a score of 1.0 represented the fewest positive responses about sports supplement use, and a score of 5.0 represented the most positive responses possible.

Scales are the most concise way to examine theoretical questions, but, for intervention (practical) purposes, one would also like to know which of the specific attitudes, norms, and intentions are most influential in affecting use of sports supplements. For this purpose, the authors ran three additional models. In the first of these, the demographic variables were entered first, as controls, along with the summary scale measuring norms. Then stepwise logistic regression was used to select those individual attitude items that added significantly to the predictive power

of the model. Similarly, stepwise logistic regression was used to select the significant attitude items, with demographic variables and the norms scale controlled. Finally, the stepwise procedure was used in a third model to select the significant intention items, controlling for demographics, the norms scale, and the attitude scale.

To measure interscholastic sport participation, participants were asked, "What sport(s) do you play for your school? Please list below." The survey allowed respondents to write up to six different sports. Sports participation for males and females within this sample included basketball, soccer, swimming, and track. Female athletes also mentioned softball, volleyball, and other sports (i.e., diving, golf, tennis, and gymnastics). For male athletes, additional sports included baseball, football, and other (diving, golf, tennis, and wrestling).

### *Data Analysis*

Binary logistic regression was used to determine the predictors of sports supplement use. The target behavior in question was dichotomous and, thus, the use of logistic regression was the most appropriate analysis (2). Logistic regression has been shown to have several desirable properties that suit it for epidemiological and health contexts (21,29). All analyses were performed using SPSS® for Windows 11.1.

## Results

The sample included 1,737 student athletes enrolled in grades 9–12 at high schools in northern Georgia. Participants included 1,014 (58.4%) male student athletes and 721 (41.6%) female student athletes. The largest percentage of participants was 10th graders (30.7%) and the lowest percentage was 12th graders (19.1%). The largest racial/ethnic group of participants represented in the sample was White (82.4%). Demographic information is presented in Table 1.

The first logistic regression model (Model 1) included only demographic variables, whereas the second logistic regression model (Model 2) included demographic variables and scales for attitude and subjective norms. The third model (Model 3) included all previously mentioned variables plus the intention scale (Table 2). These models were chosen so as to examine the following: first, the total effects of the demographic variables on supplement use; second, how the effects of demographics characteristics are mediated by attitude and subjective norms; and third, how all of the preceding effects are mediated by intention.

Results from Model 1 showed that sex was a significant predictor of sport supplement use. The odds ratio (OR) showed that males had 87% higher odds of supplement use than females (OR = 1.87, $p < .001$). This significance, however, did not persist when attitude and subjective norms were controlled in Model 2. Hence the greater usage rate for males was attributable to their more favorable attitude and normative influences.

By contrast, the higher usage rate for older students as compared with younger ones (as measured by grade level) was not much mediated by attitude, norms, or intention. Grade was a significant predictor in Models 1, 2, and 3. In other words, over and above any differences in attitude, norms, or stated intentions regarding the use of sports supplements, students were increasingly likely to report actual use of those supplements as their grade level increased. Controlling for all variables in Model 3, the odds of using sports supplements in the 12th grade were 64%

**Table 2 Odds Ratios (OR) with 95% Confidence Intervals (CI) for Predictors of Dietary Supplement Use**

| Variable | Model 1 OR (95%CI) | Model 2 OR (95%CI) | Model 3 OR (95%CI) |
|---|---|---|---|
| Sex | | | |
| male | 1.87*** | 1.19 | 1.19 |
| | (1.48, 2.37) | (.92, 1.54) | (.91, 1.54) |
| Grade | 1.20*** | 1.19** | 1.18*** |
| | (1.08, 1.33) | (1.06, 1.34) | (1.05, 1.33) |
| Ethnicity | | | |
| White | .80 | .88 | .83 |
| | (.55, 1.16) | (.59, 1.32) | (.55, 1.25) |
| African American | .62 | .61 | .65 |
| | (.37, 1.06) | (.34, 1.09) | (.36, 1.16) |
| Multisport participation | 1.74*** | 1.57*** | 1.56*** |
| | (1.38, 2.18) | (1.23, 2.02) | (1.21, 2.00) |
| Attitude[a] | 2.08*** | 1.90*** | |
| | (1.69, 2.56) | (1.52, 2.38) | — |
| Subjective norms[a] | 1.83*** | 1.46** | |
| | (1.43, 2.27) | (1.12, 1.92) | — |
| Intention[a] | 1.67*** | | |
| | (1.28, 2.17) | — | — |
| Model fit | | | |
| model chi square (*df*)[b] | .000*** | .000*** | .000*** |
| | (5) | (7) | (8) |
| Hosmer-Lemeshow (*df*)[c] | .594 | .570 | .619 |
| | (8) | (8) | (8) |

[a]Original scales are from the previously validated Survey to Predict Adolescent Athletes' Dietary Supplement Use (Perko, 1995; 2000) and include 10 attitude items, 13 items for subjective norms, and 13 intention items. Reliability tests on all three scales yield a Cronbach's alpha of .89 or higher. [b]Model significance indicates at least one of the variables in the model is related to the odds of use. [c]In the Hosmer-Lemeshow goodness-of-fit chi-square test, statistical significance would indicate a lack of fit for the model as specified. **$p < .01$. ***$p < .001$.

greater than for athletes in the 9th grade. This was determined by raising the OR (1.18) for the grade variable to the power of 3, for a three-step increase in grade level (see Agresti & Finlay, 1997, p. 581, for discussion of this technique).

Grade was tested in Model 3 as an interval variable and also (in Model 4, not shown) as a categorical variable. The difference in chi square between these two models was 2.12 with 2 degrees of freedom ($p > .25$). Thus a categorical model was not significantly better than the model with a linear effect of grade on the log-odds of use. This suggests that the OR between any two adjacent grade categories

were all approximately the same (none significantly different from 1.18). Consequently, grade was reported in Table 2 solely as an interval variable.

Student athletes who reported participating in two or more sports had 74% greater odds of using sports supplements when sex, grade, and race/ethnicity were held constant (OR = 1.74, $p < .001$). This compares with 56% greater odds of using supplements when intention, attitude, and subjective norms were also controlled (OR = 1.56, $p < .001$). Hence the latter variables only partly mediated the effect of multisport participation. Multisport athletes were significantly more likely to report actual use of sports supplements than were single-sport athletes, even with attitude, norms, and stated intention for use held constant.

Attitude was a significant predictor of sports supplement use. Even when both intention and subjective norms were controlled, along with all of the other variables in Model 3, the odds of using sports supplements nearly doubled (OR = 1.90, $p < .001$) for each one-point change in attitude toward dietary supplement use. The odds of using dietary supplements increased by a factor of 13 for those athletes who reported a maximally positive attitude toward sports supplement use (a score of 5.0 on the attitude scale), compared with those who reported the most negative possible attitude (a score of 1.0), holding other variables constant. This was determined by raising the OR of 1.90 to the power of 4, for a four-step increase in the attitude score.

Subjective norms also predicted sports supplement use significantly. In Model 2 (controlling for attitude and demographics, but with no control for intention) the effect of norms nearly doubled the odds of use for each additional point on the norms scale (OR = 1.83, $p < .001$). This effect was only partly mediated by intention in Model 3 (OR = 1.46, $p < .01$). Controlling for all variables, the odds of dietary supplement use increased by a factor of 4.5 for athletes who reported maximally favorable subjective norms, compared with those who reported the least favorable subjective norms. This was determined by taking the OR of 1.46 to the power of 4, for a four-step increase in subjective norms score.

Controlling for all demographics, attitude, and norms, each additional point on the intention scale increased the odds of use by 67% (OR = 1.67, $p < .001$). The odds of using sports supplements increased nearly eightfold for those respondents who reported the highest intention to use sports supplements compared with those who reported the lowest intention, with all other variables in the model held constant (1.67 to the power of 4).

Model chi-square tests on all three models in Table 2 were highly significant ($p < .0005$), confirming that one or more of the predictors was related to supplement use. Hosmer-Lemeshow fit tests were also conducted on the three models and all were nonsignificant at the .05 alpha level. This suggests that the model does fit and that no significant interactions or nonlinearities have been omitted.

Athletes who reported believing more strongly that taking sports supplements was safe because they are tested by scientists had 46% greater odds of use (OR = 1.46, $p < .001$). One seemingly anomalous finding is that, with everything else controlled, those student athletes who disagree with the statement “dietary supplements are safe because professional athletes take them” are more likely to take sports supplements themselves. This result is open to either a methodological or substantive interpretation. Methodologically it may simply be an artifact of multicollinearity—that is, trying to examine simultaneously the effects of many different interconnected attitude items, which presents statistical difficulties.

**Table 3 Odds Ratios (OR) with 95% Confidence Intervals (CI) for Attitudinal Predictors of Sports Supplement Use**

| Variable | OR | 95% CI |
|---|---|---|
| Sex | | |
| male | 1.14 | .86, 1.50 |
| Grade | 1.21** | 1.07, 1.36 |
| Ethnicity | | |
| White | .90 | .59, 1.37 |
| African American | .71 | .39, 1.30 |
| Multisport participation | 1.57*** | 1.22, 2.02 |
| Subjective norm scale | 1.54*** | 1.20, 1.97 |
| Attitude items | | |
| Taking dietary supplements is safe because they are tested by scientists. | 1.46*** | 1.26, 1.69 |
| Taking dietary supplements would give me more energy. | 1.30** | 1.10, 1.54 |
| Taking dietary supplements would help prevent my getting a cold or the flu.[a] | — | — |
| Taking dietary supplements would help all athletes do better in sports.[a] | — | — |
| Taking dietary supplements is a safe way for athletes to improve sports performance.[b] | — | — |
| Taking dietary supplements is a good way to build muscles | 1.23** | (1.05, 1.45) |
| Athletes my age need dietary supplements to improve sports performance.[a] | — | — |
| Athletes my age need dietary supplements for general health reasons. | 1.35*** | 1.17, 1.56 |
| Dietary supplements are safe because professional athletes take them.80** (.69, .92) | — | — |
| Dietary supplements work because professional athletes take them.[a] | — | — |
| Model fit | | |
| model chi square (*df*)[c] | .001 | 11 |
| Hosmer-Lemeshow (*df*)[d] | .291 | 8 |

[a]Excluded from the model because not a significant predictor (either linear or categorical) in the stepwise logistic regression. [b]Variable would be significant if brought into the model as a categorical predictor (i.e., with a nonlinear effect on the log-odds of supplement use). [c]Model significance indicates at least one of the variables in the model is related to the odds of use. [d]In the Hosmer-Lemeshow goodness-of-fit chi-square test, statistical significance would indicate a lack of fit for the model as specified.
**$p < .01$. ***$p < .001$.

Substantively, however, it might be that respondents believe sports supplements are unsafe because professional athletes do so as well (Table 3).

Table 4 shows subjective norm variables that were found to significantly increase the odds of use of sports supplements. Greater odds of use were related to the perceived support of parents or guardians of the athlete for taking supplements for general health reasons (OR = 1.46, $p < .001$) and better sports performance (OR = 1.21, $p < .05$). Greater perceived support of use for better sports performance from their doctor also increased the odds of use significantly (OR = 1.19, $p < .05$). Additionally, athletes who reported that they generally want to do what their doctor wants them to had lower odds of using sports supplements (OR = .83, $p < .01$).

Student athletes who intended to use sports supplements to improve their sports performance had nearly double the odds (OR = 1.88, $p < .001$) of actually using sports supplements (Table 5). Athletes' odds of use for general health reasons were also significantly greater (OR=1.23, $p < .01$). Odds of use were also significantly greater for those athletes who had greater intention to use supplements and if their parents or guardians bought them for the athlete (OR = 1.19, $p < .05$). Conversely, athletes had lower odds of use if they did not intend to ask their parents or guardians whether supplements worked (OR = .83, $p < .001$).

## Discussion

Three studies to date have compared the use of sports supplements among adolescent athletes by sex and all found that males were more likely than females to take sports supplements (20,24,25). Recent studies have also found that sports supplement use increases with grade level (20,24,27,29), and participation in multiple sports (19). There is no previous literature, however, that investigates the relationship between the above demographic factors, attitude, and subjective norms regarding the use of sports supplements. The results of this study shed new light on these issues.

In the present study, male high school athletes were indeed more likely to use sports supplements than were female athletes. Further analysis, however, showed this to be true mainly because males held more favorable attitudes and subjective norms regarding the use of supplements. On the other hand, athletes of either sex who participated in more than one sport also held more favorable attitudes toward sports supplements, and they believed that salient others in their life thought they should take sports supplements. Yet their attitudes, norms, and stated intentions did not completely account for the higher rates of self-reported use. Similarly, intention, attitude, and subjective norms mediated very little of the predictive power of grade level. This suggests that athletes' odds of using sports supplements increased throughout their high school career, regardless of their attitude and their perception of salient others' beliefs toward supplement use.

Attitudes have previously been reported as the best predictor of intention to use sports supplements marketed to enhance athletic performance among adolescent athletes enrolled in grades 9–12 (6). The current findings support and extend this small but revealing body of recent literature. Here, too, attitude was a better predictor than subjective norms, but the dependent variable was the reported use of supplements, not just intention to use. Attitude and subjective norms had both a direct and indirect effect on supplement use, with intention mediating their predictive power to a small degree.

**Table 4 Odds Ratios (OR) with 95% Confidence Intervals (CI) for Subjective Norm Predictors of Sports Supplement Use**

| Variable | OR | 95% CI |
|---|---|---|
| Sex | | |
| male | 1.15 | .88, 1.51 |
| Grade | 1.18** | 1.05, 1.32 |
| White | .96 | .64, 1.45 |
| African American | .66 | .37, 1.20 |
| Multi-sport participation | 1.53*** | 1.19, 1.97 |
| Attitude Scale | 1.87*** | 1.51, 2.33 |
| Subjective norm items | | |
| My coach would support my using dietary supplements to improve sports performance.[a] | — | — |
| My coach would support my using dietary supplements for general health reasons.[a] | — | — |
| My parent(s) or guardian would support my using dietary supplements for general health reasons. | 1.46*** | 1.25, 1.70 |
| My parent(s) or guardian would support my using dietary supplements for better sports performance. | 1.21* | 1.03, 1.43 |
| My teammates would support my using dietary supplements for better sports performance.[a] | — | — |
| My teammates would support my using dietary supplements for general health reasons.[a] | — | — |
| My doctor would support my using dietary supplements to improve sports performance. | 1.19* | 1.01, 1.39 |
| My doctor would support my using dietary supplements for general health reasons.[b] | — | — |
| My team's athletic trainer would support my using dietary supplements to improve sports performance.[a] | — | — |
| My team's athletic trainer would support my using dietary supplements for general health reasons.[a] | — | — |
| Generally speaking, I want to do what my parent(s) or guardian want me to do.[a] | — | — |
| Generally speaking, I want to do what my coach wants me to do.[a] | — | — |
| Generally speaking, I want to do what my doctor wants me to do. | .83** | .73, .93 |
| Model fit | | |
| model chi square (*df*)[c] | .000 | 10 |
| Hosmer-Lemeshow (*df*)[d] | .324 | 8 |

[a]Excluded from the model because not a significant predictor (either linear or categorical) in the stepwise logistic regression. [b]Variable would be significant if brought into the model as a categorical predictor (i.e., with a nonlinear effect on the log-odds of supplement use). [c]Model significance indicates at least one of the variables in the model is related to the odds of use. [d]In the Hosmer-Lemeshow goodness-of-fit chi-square test, statistical significance would indicate a lack of fit for the model as specified.
*$p < .05$. **$p < .01$. ***$p < .001$.

**Table 5 Odds Ratios (OR) with 95% Confidence Intervals (CI) for Intention Predictors of Sports Supplement Use**

| Variable | OR | 95% CI |
|---|---|---|
| Sex | | |
| male | .90 | .68, 1.20 |
| Grade | 1.11 | .98, 1.25 |
| Ethnicity | | |
| White | .84 | .55, 1.30 |
| African American | .78 | .42, 1.45 |
| Multi-sport participation | 1.48** | 1.14, 1.92 |
| Attitude scale | 1.39** | 1.10, 1.78 |
| Subjective norm scale | 1.32* | 1.01, 1.72 |
| Intention items | | |
| I would use dietary supplements to improve my sports performance. | 1.88*** | 1.60, 2.20 |
| I would use dietary supplements to improve my general health rather than for better sports performance. | 1.23** | 1.07, 1.42 |
| I would use dietary supplements if my coach gave them to me.[a] | — | — |
| I would use dietary supplements if my parent(s) or guardian were taking them.[a] | — | — |
| I would use dietary supplements if an athletic trainer gave them to me.[b] | — | — |
| I would ask my coach if dietary supplements are safe.[a] | — | — |
| I would ask my coach if dietary supplements work.[a] | — | — |
| I would ask my parent(s) or guardian if dietary supplements are safe.[a] | — | — |
| I would ask my parent(s) or guardian if dietary supplements work. | .81*** | .71, .91 |
| I would use dietary supplements that I know work.[a] | — | — |
| I would use dietary supplements that I know were tested and safe.[a] | — | — |
| I would use dietary supplements if I could afford to buy them.[a] | — | — |
| I would use dietary supplements if my parent(s) or guardian bought them for me. | 1.19* | 1.03, 1.39 |
| Model fit | | |
| Model Chi Square (*df*)[c] | .000 | 11 |
| Hosmer-Lemeshow (*df*)[d] | .014 | 8 |

[a]Excluded from the model because not a significant predictor (either linear or categorical) in the stepwise logistic regression. [b]Variable would be significant if brought into the model as a categorical predictor (i.e., with a nonlinear effect on the log-odds of supplement use). [c]Model significance indicates at least one of the variables in the model is related to the odds of use. [d]In the Hosmer-Lemeshow goodness-of-fit chi-square test, statistical significance would indicate a lack of fit for the model as specified. If the lone intention variable that is significant when brought in as categorical (see [b] above) is added to the model, the Hosmer-Lemeshow ceases to be significant.
*$p < .05$. **$p < .01$. ***$p < .001$.

Intention to use sports supplements, surprisingly, was not as strong a predictor as was attitude when all other variables were controlled. Theoretically, attitude and subjective norms are determinants of behavioral intention, and intention, in turn, is a direct determinant of behavior. Therefore, the Theory of Reasoned Action predicts that the influence of attitude and subjective norms would be largely mediated through intention, leaving intention as the strongest determinant of use. The findings here indicate that further theoretical and/or methodological attention to this linkage is in order. Apparently, intentions and behavior are more loosely coupled than the theory predicts, or, perhaps, the measurement of the theory's key constructs could benefit from further refinement.

The findings of this study begin to provide a profile of adolescents who are more likely to take sports supplements. Just as important, the findings also offer information to begin developing prevention and intervention strategies focused on educating adolescent athletes on the use of supplements.

Physicians, health educators, nurses, athletic trainers, and coaches involved with adolescent athletes will have more information so that they can educate, assist, and collaborate with others involved in youth sports in order to provide consistent messages and develop appropriate prevention and intervention strategies directed at the use of sports supplements. More specifically, prevention and intervention strategies can be more carefully formulated to target specific groups of athletes based on demographic characteristics such as sex, grade in school, and participation in multiple sports.

For example, a general program directed at the entire student athlete population may not be effective for everyone. An educational intervention could be tailored differently for male and female athletes. In addition, because the odds of use increase with grade level, interventions should begin in junior high or middle school and occur each year throughout high school.

Intervention strategies should address factual information and focus on the attitudes that put adolescent athletes at risk. Therefore, instead of focusing on the negative outcomes of using sports supplements, more attention could be paid to attitudes toward dietary supplement use at the point in time when athletes are deciding whether to use dietary supplements. The results of the present study are the first to shed light on specific attitudes that increase the odds of sports supplement use. Student athletes had greater odds for using supplements because they believed sports supplements are safe (because they are tested by scientists), would give them more energy, and are a good way to build muscles.

Professionals working with student athletes could focus on these beliefs when discussing sports supplements with student athletes. Specifically, student athletes could be told that the dietary supplement industry is unregulated, the FDA does not test supplements before they are put on shelves for sale, and testing is required only after adverse effects are reported to the FDA by consumers. In addition, the lack of scientific evidence for the efficacy of sports supplements has been clearly documented (17,30), and specific messages focusing on this lack of evidence for the energy-enhancing and muscle-building properties of supplements could be communicated to athletes as well. Further, the fact that supplements have not been tested on adolescents could be stated to address athlete's beliefs related to both efficacy and safety issues.

The results of the current study show that adolescent athletes' use of sports supplements is for both general health reasons and to improve sports performance. Student athletes could be told that research suggests that it is unnecessary for

adolescents, in general, to take dietary supplements to enhance athletic performance or general health (11,28). For example, iron, zinc, and other deficiencies among female and male adolescents are mostly because of low calorie intake (30); a well-balanced diet that meets the energy needs of young athletes provides all the nutrients necessary (11).

Current studies tend to focus on educating athletes and others about specific sport supplements. Perhaps a more effective approach is to address the athletes' attitudes toward sports supplements in general and the influence of salient others on their decision to use sports supplements. There will always be another new sports supplement promising bigger and better results.

Education should not be limited to athletes, but should include those on whom the athletes appear to depend when making decisions about the use of sports supplements. Coaches and athletic trainers (17), as well as others who are in contact with adolescent athletes, would be well served to educate themselves and other influential individuals regarding sports supplements using scientific research and to recognize the role they, themselves, play in adolescent athletes' decision-making processes.

Results of the present study suggest that the perceived support of parents and doctors are most important in a student athlete's decision to use sports supplements. Parents and doctors could have a tremendous effect on student athletes' supplement use if they made it clear that they do not support the use of sports supplements for either general health reasons or to improve sports performance. The role of parents is further highlighted by the present findings, which suggest that athletes who reported that they would be more likely to use supplements if their parent(s) or guardian(s) bought them for them had significantly greater odds of use. Conversely, if athletes' reported that they intended to ask parents or guardians if supplements work, the odds that they would use supplements were lower. This may suggest that athletes do not want to approach their parents about supplements for fear that a lack of parental support might, in fact, exist. As a result, parents should also be educated about the benefits and risks associated with sports supplements, as well as the influence they have on their child's decision whether to use sports supplements. Parental influence is especially significant for female athletes (6).

The role of physicians should not be overlooked. Physicians have contact with most, if not all, athletes during annual physical examinations. One study found that nearly 9 in 10 (86%) adolescent athletes reported physicians as the most credible source of information regarding muscle development (17). It has also been reported that adolescent athletes are least likely to believe that physicians would support their use of sports supplements for enhanced sports performance (25%) or general health reasons (42.8%) (23). The same study found that two-thirds (66.3%) of adolescent athletes were most motivated to comply with what their physicians wanted them to do. Results of the present study support these findings. Athletes who reported more strongly believing that their doctor would support their use of supplements to improve sports performance had significantly greater odds of actual use. In addition, athletes who held more favorable normative beliefs that, generally speaking, they wanted to do what their doctors wanted them to do, had lower odds of using supplements. This might suggest that student athletes truly believe that their doctors would not want them taking sports supplements. Inclusion of physicians among salient others in program planning and implementation is recommended.

There are several limitations to this study that should be considered when interpreting these data. First, the sample was one of convenience from a suburban community in the southeastern United States. Although a large number of athletes were surveyed, the findings should not be generalized to all adolescent athletes. Second, the data were collected in a self-report format, which could influence participants' responses through role taking, telescoping, the questionnaire promoting change in the respondent, and change in the understanding of the questionnaire by the respondent (31). Also, as noted earlier, a strict test of the theory guiding this research would require data collection over time rather than the present cross-sectional design.

Sports-supplement research has drawn educational insights from subclinical and after-the-fact studies for too long. This has not effectively countered athletes' tendencies to use these products. As such, more behavioral researchers are applying social science theories to better understand the normative and social environments in which athletes make decisions about these products. This research has identified salient subareas that clearly show the complex variables that go into the decision to take or not take these products. The authors firmly believe that a broader view needs to be embraced in order to ensure effective and long-lasting outcome-based interventions.

## References


1. Aarts, T., (Ed.). *Sports Nutrition 2000.* San Diego, CA: Nutrition Business Journal, 2000. Volume 5, No. 12.
2. Agresti, A., and B. Finlay. *Statistical methods for the social_sciences. 3rd ed*. Upper Saddle River, NJ: Prentice Hall, 1997.
3. Armsey, T.D., Jr., and G.A. Green. Nutrition supplements: science vs hype. *Phys. Sportsmed*. 25:76-84, 1997.
4. Barron, R., and G. VanScoy. Natural products and the athlete: facts and folklore. *Ann. Pharmacother*. 27:607-15, 1993.
5. Dietary Supplement Health and Education Act of 1994, S. 784, 103d Cong., 2nd Sess. 1994.
6. Dunn, M.S., J.M. Eddy, M.A. Perko, and R.T. Bartee. Influence of parents, coaches, and trainers on attitudes, subjective norms, and intentions regarding dietary supplement use among male and female adolescent athletes. *Adol. Fam. Health*. 2:141-46, 2001.
7. Dunn, M.S., J.M. Eddy, M.Q. Wang, S. Nagy, M.A. Perko, and R.T. Bartee. The influence of significant others on attitudes, subjective norms and intentions regarding dietary supplement use among adolescent athletes. *Adolescence*. 36:583-91, 2001.
8. Eddy, J.M. Publisher's Note. *Am. J. Health Stud*. 15:80, 1999.
9. Fishbein, M., and I. Ajzen. *Belief, attitude, intention and behavior: an introduction to theory and research*. Reading, MA: Addison-Wesley, 1975.
10. Green, G.A., D.H. Catlin, and B. Starcevic. Analysis of over-the-counter dietary supplements. *Clin. J. Sport Med.* 11:254-59, 2001.
11. Grisogono, V. *Children and sport: fitness injuries and diet.* London, UK: John Murray Ltd., 1991.
12. Grunewald, K., and R. Bailey. Commercially marketed supplements for bodybuilding athletes. *Sports Med*. 15:90-103, 1993.

13. Haller, C.A., and N.L. Benowitz. Adverse cardiovascular and central nervous system events associated with dietary supplements containing ephedra alkaloids. *N. Engl. J. Med.* 343:1833-38, 2000.
14. Headley, S., and S. Massad. *Nutritional supplements for athletes.* Reston, VA: NASPE, 1999.
15. Jenkins, A.P. Herbal energizers: speed by any other name. *J. Phys. Educ. Recreation Dance*. 68:39-45, 1997.
16. Lightsey, D.M., and J.R. Attaway. Deceptive tactics used in marketing purported ergogenic aids. *Nat. Strength Cond. Assoc. J.* 14:26-31, 1992.
17. Marquart, L., and J. Sobal. Beliefs and information sources of high school athletes regarding muscle development. *Pediatr. Exerc. Sci*. 5:377-382.
18. Massad, S.J., N.W. Shier, D.M. Koceja, and N.T. Ellis. High school athletes and nutritional supplements: a study of knowledge and use. *Int. J. Sport Nutr*. 5:232-45, 1995.
19. McGuine, T.A., J.C. Sullivan, and D.T. Bernhardt. Creatine supplementation in high school football players. *Clin. J. Sport Med*. 11:247-53, 2000.
20. Metzl, J.D., E. Small, S.R. Levine, and J.C. Gershel. Creatine use among young athletes. *Pediatrics*. 108:421-25, 2001.
21. Peng, C.J., B.D. Manz, and J. Keck. Modeling categorical variables by logistic regression. *Am. J. Health Behav*. 25:278-84, 2001.
22. Perko, M.A. Development of a theory-based instrument regarding adolescent athletes and dietary supplements. *Am. J. Health Stud*. 15:71-80, 1999.
23. Perko, M.A., R.T. Bartee, M.S. Dunn, M.Q. Wang, and J.M. Eddy. Giving new meaning to the term "Taking one for the team": influences on the use/non-use of dietary supplements among adolescent athletes. *Am. J. Health Stud*. 16:99-106, 2000.
24. Ray, T.R., J.C. Eck, L.A. Covington, R.B. Murphy, R. Williams, and J. Knudtson. Use of oral creatine as an ergogenic aid for increased sports performance: perceptions of adolescent athletes. *South. Med. J*. 94:608-15, 2001.
25. Smith, J., and D.L. Dahm. Creatine use among a select population of high school athletes. *Mayo Clin. Proc*. 75:1257-63, 2000.
26. Sobal, J., and L.F. Marquart. Vitamin/mineral supplement use among athletes: A review of the literature. *Int. J. Sports Nutr*. 4:320-34, 1994.
27. Swirzinski, L., R.W. Latin, K. Berg, and A. Grandjean. A survey of sport nutrition supplements in high school football players. *J. Strength Cond. Res*. 14:464-69, 2000.
28. Swygert, L.A., E.F. Maes, L.E. Sewell, L. Miller, H. Falk, and E.M. Kilbourne. Eosinophilia-myalgia syndrome. Results of national surveillance. *JAMA* 264:1698-703, 1990.
29. Wang, M.Q., J.M. Eddy, and E.C. Fitzhugh. Application of OR and logistic models in epidemiology and health research. *Health Values.* 19:59-62, 1995.
30. Williams, M.H. *The ergogenic edge: pushing the limits of sports performance*. Champaign, IL: Human Kinetics, USA, 1998.
31. Windsor, R., T. Baranowski, N. Clark, and G. Cutter. *Evaluation of health promotion, health education and disease prevention programs. 2nd ed.* Mountain View, CA: Mayfield, 1994.