


Prevalence of Protein and Pre-Workout Supplement Use among High School Football Players and Potential Product Contamination

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Abstract

The purpose was to determine the prevalence of protein and pre-workout supplement usage in high school football players and how many products contained banned substances or dangerous ingredients. A national sample of 102 high school football players was recruited via Qualtrics Research Panels to complete a cross-sectional online questionnaire. Data were summarized as means with standard deviations (SDs) and frequencies with proportions (%). A majority (59.8%) of high school football players reported currently using a protein supplement. Just under one-third (29.4%) reported currently using pre-workout supplements. Five participants reported using a pre-workout product that contained a known NCAA banned substance. Many of the products used contain banned, regulated elsewhere, or unknown substances. Secondary school ATs must educate athletes regarding the use of nutritional supplements and the potential dangers of ingesting banned or unknown substances.

Keywords

high school football, supplement usage, pre-workout, protein

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Introduction

The supplement industry has grown substantially in recent decades, with an increased use in sports at all levels. In 2016, the overall economic impact of the dietary supplement industry accounted for \$122 billion.¹ According to a Forbes article published in 2018, 3-quarters of adults in the United States take dietary supplements, up from 65% since 2009.² Pre-workout supplementation is newer to the nutritional supplement market but is gaining traction, especially with companies marketing pre-workout supplements toward younger individuals by using a variety of candy flavors. To date, there has been very little research specifically about the prevalence of protein and pre-workout supplement usage in high school sports.

Generally the research on nutritional supplementation is split into 3 categories: usage and knowledge,^{3,4} physiological effects,⁵ and contamination with banned substances.^{6,7} The research to date has typically examined these categories individually, but not at the same time within one study or population. Additionally, the

existing research on nutritional supplement use has mainly focused on college or professional level athletics.⁴ According to the National Federation of State High School Associations, over 1 million athletes, grades 9 through 12, participated in American football in 2018–2019, making it the most popular boy's high school sport.⁸ However, while there has been some research focused on nutritional supplement use among adolescent athletes from a variety of sports, to our knowledge there has been no research on the use of nutritional supplements in high school football.

Therefore, there were 3 purposes of this study. First, to determine the prevalence of protein and pre-workout supplement usage in high school football

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players. Second, to determine how many of the nutritional supplements used by the players contained banned substances or substances that are not regulated by the Food and Drug Association, FDA, when found in nutritional supplements but are normally regulated in other products. The final purpose was to determine the major influences on nutritional supplement usage among high school football players.

Methods

Participants

This study was approved by the Institutional Review Board at San Diego State University. A national sample of 102 high school football players (male N=98, female N=4, age: 16.9 ± 1.2 years old) were recruited via Qualtrics to complete an anonymous, online, cross-sectional questionnaire. The criteria to participate included being between the ages of 13 and 18 and participating on their high school's football team in the previous 12 months. Participants were recruited by Qualtrics Online Samples (Qualtrics, Provo, UT) using a combination of actively managed, double-opt-in market research panels. Data collection took place over a 1-week period in February 2020.

Questionnaire

The online questionnaire consisted of (1) participant demographics, (2) protein and pre-workout supplement usage (brand, frequency of use), and (3) beliefs regarding whether protein or pre-workout supplement usage would make them stronger and/or faster. Demographic questions included age, gender, football position, years of football participation, zip code, and hours per week and months per year participating in football. Median household income was estimated based on the participant's zip code using United States Census data. Also included in the participant demographic was whether football was their primary sport, and if they participated in other sports or if they quit another sport to focus on football.

The supplement usage section consisted of whether the participant used protein or pre-workout supplements, in what form they consumed the supplement (bar, powder, pill, shake), and what brand of supplement they consumed. To select the brand, individuals were given a selection of pictures of the most popular products based on the Amazon.com top 10 most purchased items in that category. Participants were given the opportunity to select 1 or more of the products shown and were also given space to write in the names for any product they did not see listed. Participants

were then asked how often they consumed the product (once a week, 2-3 times a week, daily, more than 1 time a day) and who they consulted with when deciding which product, they would consume. They also reported whether they believed the supplement they were consuming improved their strength or speed.

Statistical Analysis

Data were summarized as means with standard deviations (SDs) and frequencies with proportions (%). Chi-square analyses were used to examine potential associations between football participation variables and supplement usage. Independent *t*-tests were used to determine potential differences in age and median household income based on supplement usage. All statistical analysis was conducted using SPSS.

Ethical Approval and Informed Consent

This study was reviewed and approved by the Institutional Review Board at San Diego State University (Protocol Number: HS-2020-002). Due to the anonymous nature of this study, the IRB waived the requirement for signed parental informed consent or child assent, since the participant's signature would be the only record linking them to the study data.

Results

Demographic data for the 102 participants (4 females, 98 males, age: 16.9 ± 1.2 years old) are presented in Table 1.

Of the 102 participants who completed the survey, 61 (59.8%) reported using protein supplements. Frequency of supplement usage is presented in Table 2. Approximately one-third of participants (N=31, 30.4%) reported using protein supplements 2 to 3 times per week. Only 30 participants (29.4%) reported using pre-workout supplements. Table 3 depicts overall beliefs about the potential effects of protein and pre-workout supplements. Among protein supplement users, 34.4% believed it was moderately likely that protein supplements would improve their strength, while 19.7% believed it was moderately likely that protein would improve their speed. Among pre-workout supplement users, only 33.3% percent believed it was moderately likely to increase their strength and only 30% percent believed it was moderately likely to increase their speed. Knowledge about supplements used is presented in Table 4. Only 24.6% of protein-users reported being very or extremely knowledgeable about protein supplements and only 26.7% of pre-workout users reported

Table 1. Participant Demographics.

Variable	N (%) or mean (SD)
Sex	
Male	98 (96.1%)
Female	2 (3.9%)
Age (years)	16.9 (1.2)
Years of football participation	4.9 (2.7)
Median household income	\$64 164 (25 547)
Primary position	
Quarterbacks	11 (10.78%)
Running backs	11 (10.78%)
Wide receivers	16 (15.69%)
Tight ends	7 (6.86%)
Offensive linemen	16 (15.69%)
Defensive linemen	13 (12.75%)
Linebackers	13 (12.75%)
Cornerbacks	3 (2.94%)
Safeties	6 (5.88%)
Kickers	6 (5.88%)

Table 2. Protein Supplement Prevalence of Use.

Frequency of use	Number of respondents (%)
Never	41 (40.2%)
Once a week or less	11 (10.8%)
2-3 times a week	31 (30.4%)
Daily	18 (17.7%)
Multiple times a day	1 (1.0%)

being very or extremely knowledgeable about pre-workout supplements.

In total, the participants reported using 15 different protein products and 8 different pre-workout. Eight of the 15 (53.3%) protein products and 6 of the 8 (75%) pre-workout products contained at least 1 ingredient that is normally regulated in other food industries by the FDA but is not regulated in nutritional supplements. These unknown ingredients included chemicals not listed in the NCAA or WADA banned substance list or in the FDA food additive list and were not found during a preliminary chemical name search. Some of these unknown ingredients were trademarked names whose contents could not be found. Five participants (4.9%) reported using a pre-workout product that contained deer antler velvet extract, which is a known NCAA banned substance.

There were no age differences in protein usage (protein yes: 16.9 ± 1.2 years old vs protein no: 16.9 ± 1.2 years old, $P = .91$) or pre-workout supplements (pre-workout yes: 17.0 ± 1.1 years old vs pre-workout no: 16.8 ± 1.3 years old, $P = .46$). There was no

association between playing football year-round or considering football to be their primary sport with usage of protein or pre-workout supplements ($P > .05$). There was no association between belief in likelihood of receiving an athletic scholarship and usage of protein and pre-workout supplement ($P > .05$). There was a significant difference in median household income based on protein supplement usage (protein yes: $\$68\,153 \pm 28\,467$ vs protein no: $\$58\,425 \pm 19\,572$, $P = .046$). However, there was no statistically significant association between median household income and pre-workout supplement usage (pre-workout yes: $\$69\,366 \pm 28\,328$ vs pre-workout no: $\$62\,040 \pm 24\,213$, $P = .26$).

Discussion

The most important findings of this study were that the majority of high school football athletes reported consuming protein or pre-workout supplements, and approximately 30% reported consuming pre-workout supplements. To our knowledge, this is the first study to examine protein and pre-workout supplement usage among high school football players in the United States. Another key finding was that approximately 50% of the reported protein supplements and approximately 75% of the reported pre-workout supplements contained at least 1 ingredient that is normally regulated in other food industries by the FDA but is not regulated in nutritional supplements. Approximately 5% of the respondents reported using at least 1 nutritional supplement, Bucked Up[®], that contained a WADA known banned substance, deer antler velvet extract. Finally, median household income was significantly greater among athletes who reported using protein supplements compared to athletes who did not use protein supplements.

Approximately 60% of high school football athletes reported consuming a protein supplement. This result is reflective of previous research completed in Australia that looked at the prevalence of supplement usage among high school athletes in a variety of sports.⁹ That study also found approximately 60% of the participants reported using protein supplements.⁹ At the NCAA Division III level of football, a study found that 68% of their subjects consumed a protein supplement at least weekly.⁴ That result differs slightly from the results of this study; however, the difference may be due to the previous study's limited sample of 22 defensive linemen on 1 team. In a study completed by Burns et al,¹⁰ 40.3% of NCAA Division I athletes reported using a protein supplement, similar to our findings. Another study completed in Greece concluded that 60% of adolescents regularly exercising in gyms used nutritional supplements.⁷

Table 3. Beliefs Regarding Supplement Usage and Scholarship.

	Extremely unlikely	Moderately unlikely	Slightly unlikely	Neither likely nor unlikely	Slightly likely	Moderately likely	Extremely likely
“Do you believe taking protein supplements will improve your strength?”	0 (0%)	1 (1.6%)	7 (11.5%)	11 (18.0%)	11 (18.0%)	21 (34.4%)	10 (16.4%)
“Do you believe taking protein supplements will improve your speed?”	3 (4.9%)	3 (4.9%)	8 (13.1%)	16 (26.2%)	16 (26.3%)	12 (19.7%)	3 (4.9%)
“Do you believe taking pre-workout supplements will improve your strength?”	1 (3.3%)	2 (6.7%)	2 (6.7%)	2 (6.7%)	7 (23.3%)	10 (33.3%)	6 (20%)
“Do you believe taking pre-workout supplements will improve your speed?”	1 (3.33%)	0 (0%)	3 (10%)	3 (10%)	8 (26.67%)	9 (30%)	6 (20%)
“Do you believe you will receive a football athletic scholarship?”	24 (24.5%)	19 (18.6%)	16 (15.7%)	16 (15.7%)	10 (9.8%)	8 (7.8%)	8 (7.8%)

Table 4. Participant Knowledge about Supplement Used.

	Not knowledgeable	Slightly knowledgeable	Moderately knowledgeable	Very knowledgeable	Extremely knowledgeable
Protein supplements	2 (3.3%)	19 (31.2%)	25 (41.0%)	11 (18.0%)	4 (6.6%)
Pre-workout supplement	2 (6.7%)	6 (20.0%)	14 (46.7%)	3 (10.0%)	5 (16.7%)

We found that of those who reported consuming protein supplements, approximately 50% consumed supplements 2 to 3 times a week, and approximately 30% consumed supplements daily. These results are reflective of previous research that focused on high school athletes in general, which found that 56% of protein supplement users consumed a protein supplement 1 to 3 times per week, 29% consumed 4 to 6 times per week, 14% consumed 6 to 8 times, and 2% consumed more than 8 times per week.⁹ There was no association between age and protein usage found in this study, unlike a previous study completed in Canada that found a positive correlation between age and protein supplement consumption. However, this could be due to the limited age range of our study, 13 to 18 years old, unlike the Canadian study's range of 11 to 18 years old.¹¹ Participant responses regarding knowledge level of protein supplements were significantly higher than the findings of previous research, which found that high school soccer players nutrition supplement knowledge score was 45.6%.³ This difference could be a result of a difference in emphasis and education surrounding nutritional supplements between various sports.

To our knowledge, there is a gap in the literature regarding the usage of pre-workout supplements among high school football athletes. We found that approximately 30% of high school football athletes reported

consuming pre-workout supplements. In a previous study on the topic, 25.8% of fitness studio visitors in Mainz, Germany were reported to use a “pre-workout booster.”¹² A different study in college student athletes reported that 86% took a form of pre-workout supplements.⁶ The large difference in results between our study and that study may be due to the study populations or the definition of pre-workout supplements. Ultimately, there is limited research about pre-workout usage and no known research reporting the prevalence among high school football athletes.

We found that 50% of protein supplements and 75% of pre-workout supplements contained at least 1 ingredient regulated by the Food and Drug Administration in another industry. Additionally, 5% of respondents were using a supplement containing a known banned substance, deer antler velvet extract, deemed by the World Antidoping Association. This substance is banned due to it naturally containing IGF-1, a human-like growth factor, that is banned at all levels of concentration from sport. Previous research in Greece, where the nutritional supplement industry is regulated, reported that 9% of users were found to consume nutritional supplements contaminated with doping substances.⁷ The findings from Greece may be higher than those of this study because we used the product's self-reported nutritional labels to determine ingredients and did not test the actual

physical products for contamination. Another study by Mathews⁶ found that approximately 6.4% to 8.8% of doping cases are caused by tainted supplements. A different study found that out of 634 nonhormonal dietary supplements from a multitude of countries and suppliers, 14.8% were contaminated with either hormones or prohormones.⁵ Although this study did not focus on the percentage of positive doping cases caused by tainted products or the physical contamination of products, there are similarities in the percentage of participants in this study consuming products containing illegal substances, hormones or other performance enhancing stimulants, banned from sport competition.

After the Dietary Supplement Health and Education Act was passed in 1994, the responsibility and authority for regulation of the nutritional supplement industry fell to the Food and Drug Administration. Rather than creating legislation to clearly regulate the industry, the FDA passed responsibility for safety to the manufacturers with no requirement for FDA approval or demonstration of clinical efficacy. This lack of accountability for safety has led to the high occurrences of contaminated substances found in previous studies.⁵⁻⁷ This study did not test the products selected by participants, but it did find a high percentage of products containing at least 1 ingredient that the FDA regulates in other food products and also found that 5% of participants were ingesting a product that contained a banned substance. It is possible that even more participants would have been found to be taking products that contained banned substances if we were able to test the products for contamination instead of just examining the ingredient lists.

This study analyzed the external factors of recommendation source, socioeconomic status, age, scholarship beliefs, and football position. The only significant finding was that athletes from households with higher median incomes were more likely to report consuming protein supplements. Although not significant, a similar trend was seen between median household income and pre-workout supplement use. The relationship between median household income and consumption may be due to higher disposable income that can be spent on improving a child's athletic performance. Future research within a larger sample size is needed to determine the association between median household income and supplement use. A previous study completed in Australia found a positive correlation between age and usage. It also found that coaches were most likely to initiate protein supplement usage.⁹ Those findings may differ from this study's findings because of a more limited age range in our study and because our questions did not specify the factor initiating supplement usage. Another study that included 22 NCAA Division III lineman found that 29% of athletes received information about protein

supplements from athletic trainers.⁴ Due to the decreased availability of athletic trainers at the secondary school level, high school athletes may be at a greater risk of purchasing a substance with poor substantiation because they do not have a healthcare provider who can counsel them regarding nutritional supplements.⁸ Previous research has found that coaches and athletic trainers are the most common sources of information regarding nutritional supplements, so future studies should examine sources of information when athletic trainers and strength and conditioning coaches are not present.^{3,9}

This study had several limitations that should be considered. First, the sample size was somewhat limited with only 102 participants. Future research with larger samples is needed to determine differences in supplement usage based on income or sport participation characteristics. The means by which the study was conducted were limiting because adolescent and teenage individuals self-reported, which could have caused misreporting. This study, when determining products potential danger, analyzed only what was listed on the nutritional labels but did not test the products for contamination.

Implications for Clinical Practice

The use of protein and pre-workout supplements is relatively common among high school athletes. With proper guidance and regulation nutritional supplement use is not inherently dangerous, but when coupled with minimal athlete education and the lack of industry regulation, it can lead to detrimental effects. Athletic trainers within the high school setting have the unique role of being the primary healthcare provider for many student-athletes and may be the only source of information regarding nutritional supplements. As the industry grows and the usage of these products become more common the necessity for third-party verification increases. It is vital that athletic trainers educate their participants on these third-party organizations to ensure safe use of supplements when necessary. This unique role means athletic trainers must be prepared to educate student-athletes regarding the supplement industry and the importance of third-party ingredient verification, such as by the WADA or NCAA.

Author Contributions

Tal Shoshan designed the research and wrote the manuscript. Eric Post assisted with data analysis, acquiring Institutional Review Board approval, and acquiring funds.

Declaration of Conflicting Interests

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