

The Use of Energy Drinks, Dietary Supplements, and Prescription Medications by United States College Students to Enhance Athletic Performance

Christopher O. Hoyte · Donald Albert ·
Kennon J. Heard

Published online: 1 February 2013
© Springer Science+Business Media New York 2013

Abstract While the use of performance enhancing substances by professional, collegiate, and Olympic athletes is well described, the rate of use in the general population is not well studied. We explored the use of energy drinks, dietary supplements, and prescription medications for the enhancement of athletic performance among college students using an ongoing survey system. We conducted a multi-round online questionnaire collecting data from self-identified students at two-year colleges, four-year colleges, online courses, or technical schools at least part-time during the specified sampling period. The sample is obtained through the use of a survey panel company in which respondents voluntarily register. Survey data were collected from December, 2010 through August, 2011. Subjects who reported participating in athletics were asked if they used any of the following substances to enhance athletic performance (1) energy drinks (2) dietary supplements (3) prescription medications within the last year. Data were analyzed from October, 2011 through January, 2012. There were 462 college students who responded to the survey reporting they participate in sports at various levels. Of these, 397 (85.9 %) responded that within the

last year they used energy drinks, dietary supplements, or prescription medications to enhance athletic performance. Energy drinks had the highest prevalence (80.1 %), followed by dietary supplements (64.1 %) and prescription medications (53.3 %). Use was most prevalent amongst intercollegiate athletes (89.4 %) followed by club (88.5 %) and intermural (82.1 %) participants. The vast majority of survey respondents reported using energy drinks, dietary supplements, and prescription medications within the last year for athletic performance enhancement.

Keywords College athletes · Performance enhancement · Energy drinks

Introduction

The use of energy drinks and dietary supplements such as 5-hour ENERGY®, Red Bull®, and HYDROXYCUT™ products has become widespread. The United States Substance Abuse and Mental Health Services Administration (SAMHSA) reports that energy drink-related emergency department visits increased from 1,128 in 2005 to 13,114 in 2009 [1]. Additionally, as of 2010, it is estimated that the incidence of energy drink and dietary supplement use among adolescents and young adults is 30–50 % [2]. While it is known that acute overdose of these products has been associated with toxicity, there is growing concern that chronic use of energy drinks and dietary supplements may cause neurologic and cardiovascular toxicity [3–5].

Manufacturers of some energy drinks and dietary supplements are not required to receive FDA pre-approval prior to selling their products to the consumer. Furthermore, ingredients found in energy drinks and dietary supplements such as ginseng, multivitamins, taurine, and guarana are not

The manuscript, as submitted or its essence in another version, is not under consideration for publication elsewhere, and will not be published elsewhere while under consideration by Archives of Pediatrics and Adolescent Medicine.

C. O. Hoyte · D. Albert · K. J. Heard
Rocky Mountain Poison and Drug Center, Denver Health
and Hospital Authority, 990 Bannock Street, Denver,
CO 80204, USA

C. O. Hoyte (✉) · K. J. Heard
Department of Emergency Medicine, University of Colorado
Medical Center, E. 16th Street Aurora, Aurora, CO 80045, USA
e-mail: cohoyte@yahoo.com

currently regulated by the FDA and thus there is not always quality control in the manufacturing process.

Media reports of athletes using energy drinks and dietary supplements in order to enhance athletic performance have been increasing [6]. This is not a new phenomenon. For example, the winner of the 1904 Olympic marathon, Thomas Hicks, was injected with strychnine by his trainer and drank brandy during the race when he started to struggle [7]. He was able to finish the race and was awarded the gold medal by way of the disqualification of another participant. In addition, a recent survey demonstrated widespread use and misuse of prescription opioid medications by retired National Football League Players during their playing careers [8]. However, the use of energy drinks, dietary supplements, and prescription medications across all levels of athletics is not well known. Therefore, the aim of this study is to determine the proportion of college students who report using energy drinks, dietary supplements, or prescription medications to enhance athletic performance.

Methods

Design

This was a cross sectional study of United States college students using the College Survey Program which is a part of RADARS[®]. Participants provided informed consent prior to participation. This survey program is used to estimate the scope of prescription drug use for nonmedical reasons among college students in the United States. The study protocol was reviewed and approved by our local institutional review board and participants provided informed consent prior to participation.

Subjects

Participants were self-identified students enrolled in 2-year colleges, four-year colleges, online courses, or technical schools at least part-time during the specified sampling period. College students were sent an email invitation to take the online questionnaire. Inclusion criteria included being age 18 or older and being enrolled in college during the current semester for the fall and spring launch or being enrolled during the previous semester and the following semester for the summer launch. Each launch of the questionnaire collects responses from approximately 2,000 college students. Data are collected at the completion of the fall semester (during the second 2 weeks of December), at the completion of the spring semester (during the second 2 weeks of May), and at the completion of the summer (during the first 2 weeks of August). For this study, data were collected from December, 2010 through August, 2011. The

sample is equally distributed across the four geographic regions of the United States (W, NW, S, NE).

Survey

The Survey was Disseminated by Toluna USA, Inc.

The survey is anonymous and the respondent indicates consent before providing any responses to the questionnaire. As a screen to identify subjects who are not providing meaningful responses, the survey includes several screening questions asking about the use of nonexistent products or asking participants questions with obvious answers such as the current month. Respondents who indicated the use of any nonexistent products or who answer any of the screening questions incorrectly were excluded from the study.

Measurements

In addition to the questions in the College Survey program, all respondents were asked if they participated in sports. Subjects who responded yes were asked the questions in Table 1. We also collected the subjects' primary sport and level of competition (semi-professional, intercollegiate, club, pick up).

Data Quality Assurance

The RADARS[®] system initiates a Database Quality Audit on the final, cleaned dataset at the completion of every launch. All variables were reviewed for 10 % of the cases. A population list is compiled of all questionnaires received during the relevant quarter. The population list is used to generate a 10 % random sample plan using SAS[®] Enterprise Guide[®]. A manual comparison between the online questionnaire results and the data listings for each questionnaire was then conducted. The number of errors (if any) is then documented and an error rate is calculated. If the error rate exceeds 1 %, an evaluation is conducted.

Statistics

Descriptive statistics were performed and included percentages and 95 % confidence limits. Data were analyzed from October, 2011 through January, 2012.

Table 1 Additional questions

“Within the last year, have you used an energy drink, dietary supplement, or prescription medication in order to enhance athletic performance?”
“What is your primary sport?”
“At what athletic level do you participate in your primary sport?”

Results

There were 1,960 college students who responded to the survey and 462 (23.6 %) of these responded that they participate in sports (Table 2). The majority of those who participate in sports were males (N = 276, 59.7 %) with a mean age of 20.9 years. The profile and characteristics of survey participants responding that they do not participate in athletics is displayed in Table 3.

Of the 462 who participate in sports, 397 (85.9 %) reported that they used an energy drink, dietary supplement, or prescription medication in the last year to enhance athletic performance (Table 4). Energy drinks had the highest prevalence (80.1 %) followed by dietary supplements (64.1 %), and prescription medications (53.3 %) (Table 4). For both males and females, energy drinks, 84.1

Table 2 Respondent demographic characteristics for those responding that they participate in athletics

Variable	Statistic/response	Total n = 462
Gender	Male	276 (59.7 %)
	Female	186 (40.3 %)
Hispanic	No	327 (70.8 %)
	Yes	117 (25.3 %)
	I do not wish to respond	18 (3.9 %)
Race	White (Caucasian)	302 (65.4 %)
	Black/African American	49 (10.6 %)
	Asian	53 (11.5 %)
	American Indian or Alaska Native	6 (1.3 %)
	Native Hawaiian or Pacific Islander	5 (1.1 %)
	I do not wish to respond	22 (4.8 %)
	Other	25 (5.4 %)
College type	Public	344 (74.5 %)
	Private	115 (24.9 %)
	Other	3 (0.6 %)
College length	4 year(Bachelor degree)	363 (78.6 %)
	2 year (JC or Assoc. degree)	82 (17.7 %)
	Online university	10 (2.2 %)
	Trade school	3 (0.6 %)
	Other	4 (0.9 %)
College_size	Less than 5,000 students	71 (15.4 %)
	5,000–10,000 students	141 (30.5 %)
	10,001–25,000 students	135 (29.2 %)
	Greater than 25,000 students	80 (17.3 %)
	I do not know	35 (7.6 %)
College housing	No	255 (55.2 %)
	Yes	207 (44.8 %)
Greek	No	296 (64.1 %)
	Yes	166 (35.9 %)

Table 3 Respondent demographic characteristics for those responding that they do not participate in athletics

Variable	Statistic/response	Total n = 1,498
Gender	Male	430 (28.7 %)
	Female	1,068 (71.3 %)
Hispanic	No	1,286 (85.8 %)
	Yes	181 (12.1 %)
	I do not wish to respond	31 (2.1 %)
Race	White (Caucasian)	1,061 (70.8 %)
	Black/African American	165 (11.0 %)
	Asian	144 (9.6 %)
	American Indian or Alaska Native	13 (0.9 %)
	Native Hawaiian or Pacific Islander	8 (0.5 %)
	I do not wish to respond	50 (3.3 %)
	Other	57 (3.8 %)
College type	Public	1,136 (75.8 %)
	Private	312 (20.8 %)
	Other	50 (3.3 %)
College length	4 year(Bachelor degree)	946 (63.2 %)
	2 year (JC or Assoc. degree)	427 (28.5 %)
	Online university	79 (5.3 %)
	Trade school	27 (1.8 %)
	Other	19 (1.3 %)
College_size	Less than 5,000 students	263 (17.6 %)
	5,000–10,000 students	333 (22.2 %)
	10,001–25,000 students	264 (17.6 %)
	Greater than 25,000 students	210 (14.0 %)
	I do not know	428 (28.6 %)
College housing	No	1,213 (81.0 %)
	Yes	285 (19.0 %)
Greek	No	1,391 (92.9 %)
	Yes	107 (7.1 %)

and 74.2 % respectively, had the highest prevalence of use among the three product categories (Table 5). Across the different athletic levels, use of performance enhancing substances was highest among semiprofessional athletes (93.8 %) followed by intercollegiate athletes (89.4 %), and

Table 4 Respondents who participate in athletics and have used energy drinks, dietary supplements, or prescription medications in the last year to enhance athletic performance

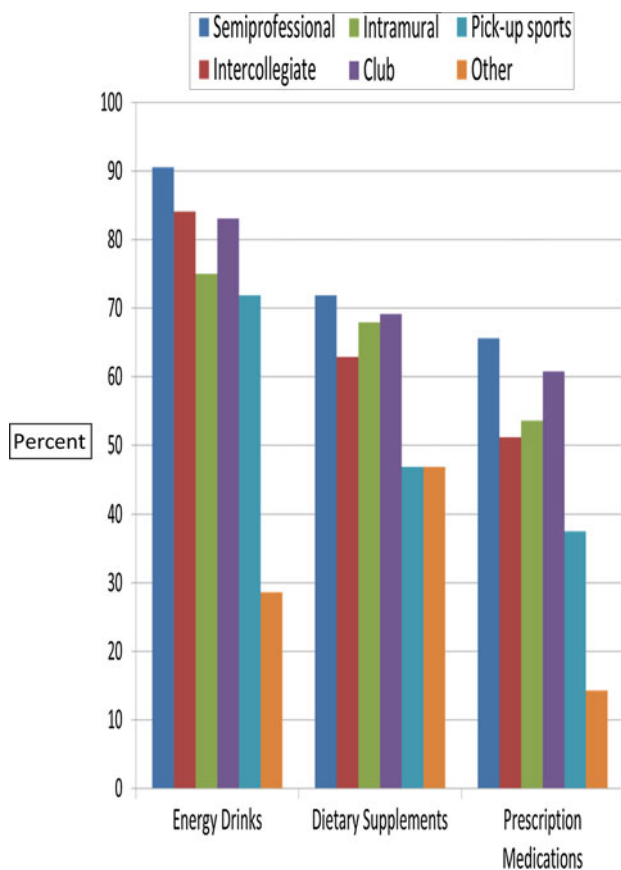
Supplements	N	Percent	Lower CL	Upper CL
Any	397	85.93	82.75	89.11
Energy drinks	370	80.09	76.43	83.74
Dietary supplements	296	64.07	59.68	68.46
Prescription meds	246	53.25	48.68	57.81

Table 5 Respondents who participate in athletics and have used energy drinks, dietary supplements, or prescription medications in the last year to enhance athletic performance by gender

Supplements	Gender	N	Percent	Lower CL	Upper CL
Any supplements	Male	246	89.13	85.44	92.83
	Female	151	81.18	75.51	86.85
Energy drinks	Male	232	84.06	79.71	88.40
	Female	138	74.19	67.85	80.54
Dietary supplements	Male	197	71.38	66.01	76.74
	Female	99	53.23	45.99	60.46
Prescription meds	Male	159	57.61	51.74	63.48
	Female	87	46.77	39.54	54.01

Table 6 Respondents who participate in athletics and have used energy drinks, dietary supplements, or prescription medications in the last year to enhance athletic performance by sport

Main sport	% (N)	Total
Swimming	93.33 (14)	15
Basketball	93.24 (69)	74
Football	93.22 (55)	59
Tennis	92.86 (26)	28
Baseball	88.89 (24)	27
Golf	83.33 (10)	12
Softball	82.35 (14)	17
Track	82.35 (14)	17
Volleyball	82.14 (23)	28
Soccer	76.00 (38)	50

**Fig. 1** Percent use of energy drinks, dietary supplements, or prescription medications in the last year to enhance athletic performance by athletic level

those who participate at the club level (88.5 %) (Fig. 1). Of the ten most represented sports in the survey, swimmers, football players, basketball players, had the highest percentage of use (Table 6). The tenth most represented sport, soccer, had a 76.0 % prevalence of energy drink, dietary supplement, or prescription medication use.

Discussion

Our study shows that performance enhancing substance use is common practice among college students who participate in athletics. Almost all reported using energy drinks, a large majority used dietary supplements, and more than half reported taking prescription medications to enhance athletic performance. Use was similar for males and females, across all sports, and across all levels of competition. The high prevalence of use of these products to enhance athletic performance may represent a significant and unrecognized health risk.

College students report using these products for various reasons [9]. Our study suggests that enhancing athletic performance may be another common reason. While the use of these products is generally safe, recent studies have suggested that some users will experience toxic effects and seek health care. It is also possible that use during sports may produce an additive effect and increase the risk of complications.

Supplement use is common among athletes in general thus it was not surprising to find a high rate of use in college student-athletes [10–12]. The risks of supplements as a group are difficult to determine; most ingredients are very safe but as the products are not regulated as pharmaceuticals, there is a potential for toxicity from either a new ingredient or contamination. Many athletes report unknowingly ingesting banned substances in sport supplements [13].

The most surprising finding in our study was the high rate of use of prescription medications to enhance athletic performance. These medications can have life-threatening effects, and the risks are increased when they are not used as directed. Furthermore, physical exertion may potentiate

the effects of some medications. For example, the effect of exercise on heart rate may be increased by stimulants. The misuse of these medications may also decrease the desired therapeutic effects. For example, taking a stimulant before an afternoon game may leave the student less able to concentrate on their homework in the evening.

While these products are commonly used, it is unclear whether these commercially available energy drinks, dietary supplements, or prescription medications actually enhance athletic performance [14]. It is clear that they do have the potential for toxicity [15].

It seems reasonable that college athletes participating semiprofessionally and intercollegiately would be far more likely to risk toxicity in order to enhance athletic performance than those participating at club or intramural levels. We were surprised to find that the prevalence of use of performance enhancing agents was similar across all levels of competition. This suggests that students participating in sports perceive that there are components of athletic performance such as running or swimming faster, jumping higher, and increased endurance that are enhanced by these agents. A follow up survey would query these athletes directly as to their rationale for consuming these products and what the perceived benefits are.

Another factor that may play a role compelling performance enhancing substance use by college students participating in athletics as a means of athletic performance enhancement may be the added perceived benefit of enduring sleep deprivation. College student-athletes have scholastic responsibilities in addition to their athletics and this can add to fatigue and a lack of sleep. A survey conducted by the American College Health Association showed that 71 % of college students experienced sleep deprivation within the past 7 days prior to the survey [16]. Thus, the college athlete may consume performance enhancing substances in order to endure sleep deprivation during their athletic event by increasing focus and alertness.

A broader question is whether use of these agents leads to the use of more infamous performance enhancing agents such as anabolic steroids and growth hormone. Also, a higher prevalence of alcohol dependency has been reported in athletes who misuse prescription medications [8]. In order to investigate these potential associations, measuring risk profiles among users and whether younger athletes such as those in high school are using performance enhancing substances would be of great use [17]. Being able to identify those athletes at risk of performance enhancing substance use and measuring the use in vulnerable athletes such as the high school student attempting to make his or her varsity team would provide a target for education and other measures employed in an attempt to limit risks to athlete health.

The fact that professional athletes use performance enhancing agents of all classification including energy

drinks likely contributes to use by college athletes [6]. Both groups of athletes are under pressure to succeed. It is likely that college student-athletes emulate the behavior of successful professional athletes including the consumption of performance enhancing agents of all types. For example, a study conducted in early 2011 demonstrated that 52 % of retired National Football League football players admitted to using prescription analgesics during their playing careers [8]. Of those, 71 % reported that they had misused these medications. The researchers also asserted that those who misused these prescription analgesics during their playing careers were three times more likely to misuse these medications in retirement than those who used them as prescribed [8]. This high prevalence of prescription medication use is not unique to the physically demanding sport of football. For example, a survey of athletes participating in the Olympic Games in both Atlanta and Sydney showed a high prevalence of prescription and over-the-counter analgesic use [18].

All athletes should be encouraged to perform at their best, but the health and safety of the athlete should always be paramount. Thus, athletes, coaches, trainers, healthcare professionals, and sports officials must endeavor to limit any risk to athlete health and well-being. In order to limit the risk of potential toxicity caused by performance enhancing substance consumption more study is needed. First, it is imperative to understand the rationale for the consumption of these agents by college student-athletes. As mentioned above, there are various reasons the college student-athlete would deem the consumption of these agents as beneficial. The college student-athlete is unique and different in many ways from the professional or even high school athlete. Therefore, directed surveys employed to specifically understand why college student-athletes consume particular performance enhancing substances would be of great value to the task of mitigating their risk of toxicity from them.

Limitations

The data abstracted is reliant upon the accurate responses of the participants of the study. Respondents choosing to give dishonest answers may do so for various reasons such as personal entertainment value or fear of consequence. A genuine attempt to mitigate this fear is made at the start, end, and throughout the survey by ensuring the participants that their responses are completely anonymous. Despite this measure, this is a threat to the internal validity of the study. Also, the participants of the study are voluntary responders. Therefore a threat to the external validity of the study is that those college student-athletes who chose to respond to the survey may not accurately represent the cohort of student-athletes as a whole.

Conclusions

The use of energy drinks, dietary supplements, and prescription medications in order to enhance athletic performance is ubiquitous across all groups of college athletes. This includes gender, sport, and athletic level.

Conflict of interest The authors have no commercial associations or sources of support that might pose a conflict of interest.

References

- Emergency Department Visits Involving Energy Drinks. (2011, November 22). United States Substance Abuse and Mental Health Services Administration Drug Abuse Warning Network. The DAWN Report.
- Seifert, S., et al. (2011). Health effects of energy drinks on children, adolescents, and young adults. *Pediatrics*, *127*, 511–528.
- Persad, L. (2011). Energy drinks and the neurophysiological impact of caffeine. *Frontier in Neuroscience*, *5*, 116.
- Rottlaender, D., et al. (2011). Cardiac arrest due to long QT syndrome associated with excessive consumption of energy drinks. *International Journal of Cardiology*, *158*(3), e51–e52.
- Steinke, L., et al. (2007). Energy drink consumption causes increases in blood pressure and heart rate. *Circulation*, *116*, II_831.
- Norwood, R. Young athletes and energy drinks: A bad mix? USA Today. <http://usatoday30.usatoday.com/sports/story/2011-12-01/ncaa-some-leagues-monitoringenergy-drink-use/51557618/1>. Accessed 12 Jan 2011.
- Pariente, R., & Lagorce, G. *La Fabuleuse Histoire Des Jeux Olympiques*. Livres Bronx Books, Lasalle, QC, Canada. ODIL France 1973.
- Cottler, L. B., et al. (2011). Injury, pain, and prescription opioid use among former National Football League (NFL) players. *Drug and Alcohol Dependence*, *116*(1–3), 188–194.
- Malinauskas, B. M., Aebly, V. G., Overton, R. F., Carpenter-Aebly, T., & Barber-Heidal, K. (2007). A survey of energy drink consumption patterns among college students. *Nutrition Journal*, *31*(6), 35.
- Metzl, J. D., Small, E., Levine, S. R., & Gershel, J. C. (2001). Creatine use among young athletes. *Pediatrics*, *108*(2), 421–425.
- LaBotz, M., & Smith, B. W. (1999). Creatine supplement use in an NCAA Division I athletic program. *Clinical Journal of Sport Medicine*, *9*(3), 167–169.
- Buckman, J. F., Yusko, D. A., White, H. R., & Pandina, R. J. (2009). Risk profile of male college athletes who use performance-enhancing substances. *Journal of Studies on Alcohol and Drugs*, *70*(6), 919–923.
- Roberts, S. (2002). OLYMPICS; Athletes Guess on Supplements. New York Times; January 30. http://www.acha-ncha.org/reports_ACHA-NCHAI.html.
- Ballard, S. L., Wellborn-Kim, J. J., & Clauson, K. A. (2010). Effects of commercial energy drink consumption on athletic performance and body composition. *The Physician and Sportsmedicine*, *38*(1), 107–117.
- Duchan, E., Patel, N. D., & Feucht, C. (2010). Energy drinks: A review of use and safety for athletes. *The Physician and Sportsmedicine*, *38*(2), 171–179.
- American College Health Association, National College Health Assessment, Reference Group Data Report, Fall 2007.
- Backhouse S. H., Whitaker L. & Petróczy A. (2011) Gateway to doping? Supplement use in the context of preferred competitive situations, doping attitude, beliefs, and norms. *Scandinavian Journal of Medicine & Science in Sports*. doi: [10.1111/j.1600-0838.2011.01374.x](https://doi.org/10.1111/j.1600-0838.2011.01374.x). [Epub ahead of print].
- Huang, S. H., Johnson, K., & Pipe, A. L. (2006). The use of dietary supplements and medications by Canadian athletes at the Atlanta and Sydney Olympic Games. *Clinical Journal of Sport Medicine*, *16*(1), 27–33.