

Dietary Supplements and Young Teens: Misinformation and Access Provided by Retailers

Maguire Herriman, Laura Fletcher, Alexis Tchaconas, Andrew Adesman, MD, Ruth Milanaik, DO

abstract

BACKGROUND AND OBJECTIVE: Despite the American Academy of Pediatrics' recommendations against pediatric use of creatine and testosterone boosters, research suggests that many young teenagers take these dietary supplements. Our objective was to determine to what extent health food stores would recommend and/or sell creatine and testosterone boosters to a 15-year-old boy customer.

METHODS: Research personnel posing as 15-year-old high school athletes seeking to increase muscle strength contacted 244 health food stores in the United States via telephone. Researchers asked the sales attendant what supplements he/she would recommend. If a sales attendant did not mention creatine or testosterone boosters initially, each of these supplements was then specifically asked about. Supplement recommendations were recorded. Sales attendants were also asked if a 15-year-old could purchase these products on his own in the store.

RESULTS: A total of 67.2% (164/244) of sales attendants recommended creatine: 38.5% (94/244) recommended creatine without prompting, and an additional 28.7% (70/244) recommended creatine after being asked specifically about it. A total of 9.8% (24/244) of sales attendants recommended a testosterone booster. Regarding availability for sale, 74.2% (181/244) of sales attendants stated a 15-year-old was allowed to purchase creatine, whereas 41.4% (101/244) stated one could purchase a testosterone booster.

CONCLUSIONS: Health food store employees frequently recommend creatine and testosterone boosters for boy high school athletes. In response to these findings, pediatricians should inform their teenage patients, especially athletes, about safe, healthy methods to improve athletic performance and discourage them from using creatine or testosterone boosters. Retailers and state legislatures should also consider banning the sale of these products to minors.

Division of Developmental and Behavioral Pediatrics, Steven and Alexandra Cohen Children's Medical Center of New York, North Shore–Long Island Jewish Health System, Lake Success, New York

Mr Herriman helped conceptualize and design the study, performed the data collection and analysis, drafted the initial manuscript, and approved the final manuscript; Ms Fletcher helped design the study, performed the screening calls, edited the initial manuscript, and approved the final manuscript; Ms Tchaconas performed the statistical analysis, edited the initial manuscript, and approved the final manuscript; Dr Adesman helped conceptualize and design the study, guided the data analysis, reviewed the manuscript, and edited the final manuscript; Dr Milanaik helped conceptualize and design the study, guided the data analysis, reviewed the initial manuscript, and edited the final manuscript.

DOI: 10.1542/peds.2016-1257

Accepted for publication Nov 16, 2016

WHAT'S KNOWN ON THIS SUBJECT: Teenage boy athletes often take supplements to improve their performance and typically purchase these supplements at health food stores. To date, however, no studies have analyzed the recommendations these stores make to young teenage boys about supplement use.

WHAT THIS STUDY ADDS: This study documents that health food stores nationally often recommend age-restricted supplements to young boy teenagers. It highlights the need to review how supplements are promoted and the important role pediatricians play in counseling youth about the risks of supplement use.

To cite: Herriman M, Fletcher L, Tchaconas A, et al. Dietary Supplements and Young Teens: Misinformation and Access Provided by Retailers. *Pediatrics*. 2017;139(2):e20161257

Downloaded from http://publications.aap.org/pediatrics/article-pdf/139/2/e20161257/1061195/peds_20161257.pdf by guest on 07 December 2021

FREE

Young boy athletes often perceive themselves as less muscular than their ideal body image, and therefore may take supplements to try to increase their muscle mass.^{1,2} In 2005, Field et al³ reported that 12% of boys reported using supplements to improve appearance, muscle mass, or strength. More recently, in a 2012 study of 2793 adolescents at 20 urban middle and high schools in Minnesota, 34.7% of boys reported using protein supplements, 5.9% used steroids, and 10.5% used some other muscle-enhancing substance.⁴ Similar prevalences were noted in the recent Growing Up Today study; in this national cohort, 12% of boys 13 to 18 years old reported using muscle-building products (ages 13–15 years: 3.2%; ages 16–18 years: 9.5%).⁵

Creatine is one of the most popular weight gain supplements among this age group; 8.8% to 21% of high school boy athletes report creatine use.^{6–9} In a study of 37 public high schools in Wisconsin, 30.1% of high school football players reported creatine use.⁶ Clearly, there is widespread use of creatine among adolescents despite the recommendations of the American Academy of Pediatrics and the American College of Sports Medicine against creatine use by those <18 years of age.^{10,11} The physiologic effects claimed by dietary supplement companies in advertising and marketing are often not supported by research.¹² Moreover, use of creatine and/or testosterone boosters may pose significant health risks to adolescents.

Although minimal research on adolescent creatine use is available, anecdotal evidence suggests that creatine may impair hepatic and renal function as well as cause dehydration and muscle cramps.^{13–15} A systematic review by Lopez et al,¹⁶ however, refuted the supposed causal connection between creatine use and dehydration. Creatine use has also

been associated with an increased risk of compartment syndrome, a condition where pressure builds in a muscle compartment and prevents bloodflow.¹⁷ Furthermore, because dietary supplements are subject to little oversight by the Food and Drug Administration (FDA), the safety and efficacy of supplements available on the market are not rigorously established.^{18,19} Pomeranz et al²⁰ note that dietary workout supplements, such as creatine, are often adulterated with pharmaceutical drugs and can lead to adverse effects, such as hypertension, stroke, and liver injury.

An additional concern of adolescent creatine use is that teenagers often do not get their information on supplement use from physicians or dietitians, leading to improper usage against medical recommendations.²⁰ Smith and Dahm⁸ found that 78% of high school creatine users either did not know how much creatine they were taking or were intentionally taking more than the dose recommended on packaging provided by manufacturers. The same study found that 86% of creatine users purchased their creatine at a health food store and that high school users list friends and health food stores as their primary sources of information on creatine.⁸ These results suggest a great deal of misinformation among high school athletes regarding creatine use. In another study, physicians ranked behind other high school athletes, friends, parents, coaches, and teachers as information sources that discourage creatine use.⁶

Testosterone boosters are another workout supplement that are advertised as improving one's strength and endurance, and therefore are also appealing to young boys. A testosterone booster is a type of herbal or synthetic supplement that increases testosterone levels in the bloodstream by either inducing the body to produce more testosterone or inhibiting

the conversion of testosterone to estrogen. However, the efficacy and safety of these products are questionable. Research on supplemental use of testosterone boosters in adults has found that it can cause polycythemia, increased blood viscosity, prostatic hyperplasia, hepatotoxic effects, hepatic neoplasia and dysfunction, and the exacerbation or development of sleep apnea.²¹ In 1 study examining the effectiveness of the purported testosterone booster *N*-Methyl-D-aspartate, investigators found it has no effect on body composition or muscle performance for those participating in resistance training.²² Although less well studied, there are concerns that adolescent use of testosterone boosters can also cause the body to shut down its natural production of testosterone as well as increase acne and halt bone growth.^{23,24}

Teens commonly get information about muscle supplements from health food stores and are most likely to purchase these supplements from these types of stores.⁸ Because many health food stores present their employees as “expert(s) in health and wellness products”²⁵ (GNC) or “knowledgeable, courteous, and extensively trained Health Enthusiasts ready to help with all your health and wellness needs”²⁶ (Vitamin Shoppe), teenagers may be led to believe that they are receiving the best possible advice. However, no research to date has investigated the quality of the information these health food stores provide to young customers. The current study aimed to fill this gap by determining what muscle gain supplements (if any) health food store personnel would recommend for a 15-year-old and the ability of a minor to purchase these supplements. The supplements of interest for this study were creatine and testosterone boosters, both of which are not recommended for adolescent populations by health care

professionals and can pose significant health risks.

METHODS

Participants

This study identified 300 health food stores in the United States for inclusion in this study. Forty-nine states were included in the sample. The institutional review board (IRB) required that New Jersey be excluded due to pending state legislation that would ban the sale of creatine to minors (www.njleg.state.nj.us/2006/Bills/S2000/1951_I1.PDF). In each of the other states, sale of creatine and testosterone boosters to minors was legal at the time of the study. Although Massachusetts introduced a bill in January 2015 to ban the sale of dietary supplements for weight loss or muscle building to minors, this study was conducted in August 2014, before the introduction of that legislation (<https://cdn1.sph.harvard.edu/wp-content/uploads/sites/1267/2015/09/Massachusetts-House-Bill-No.-34711.pdf>). Both the New Jersey and Massachusetts bills ultimately failed to be signed into law.

A health food store was defined as a store that primarily sells dietary supplements. This study divided health food stores into 2 categories: national chain and nonnational retailers. A national chain was defined as a retailer that operates at least 1 store in at least 45 states nationwide. Two national chains of health food stores were identified that fit this criterion. A nonnational retailer was any health food store that did not fit this criterion. Nonnational retailers may operate regionally or as independently owned and operated single-store locations. The initial national sample consisted of 200 national chain locations and 100 nonnational retailers. Although the intent was to have 4 national chain stores in each state included in the study, in some states, <4

eligible national chain stores could be identified. For these states, additional national chain stores were added from states in the same geographic region as the deficient state. The 4 geographic regions defined by the US Census Bureau (Northeast, South, Midwest, and West) were used for this purpose. An additional 100 nonnational retailers (25 per region) were identified using the Web site www.VPXSports.com. This Web site was used because it offers a registry of health food store locations that is searchable on a state-by-state basis.

From the initial sample of 300 stores, stores were excluded if they did not require that all employees were >18 years of age. These age requirements were introduced at the direction of the IRB. The 2 national chain retailers included in this study require that sales attendants are at least 18 years old. For the nonnational retailers, a female researcher made initial screening calls to the 100 identified locations and asked about the age requirements for employment. Stores that employed minors or that were out of business were excluded. A store was considered out of business if researchers were not able to connect on a screening call after 3 separate attempts during normal business hours. Sixty-six nonnational retailers were excluded by these criteria. The final sample consisted of 244 health food stores, of which 200 were national chain locations and 44 were nonnational retailers.

Procedures

A 20-year-old male researcher contacted each health food store in the sample by phone during normal business hours. All calls were made during August 2014. Once a sales attendant answered the phone, the researcher identified himself as a 15-year-old football player going into his sophomore year of high school. The researcher then stated that he was doing strength training and asked if the sales attendant

had any products that he/she would recommend. Recommended products were documented. If the sales attendant did not initially mention creatine and/or a testosterone booster, then the researcher asked the sales attendant for recommendations regarding these products. Creatine and testosterone boosters were asked about in separate questions, and the sales attendants' recommendations on each were documented. The researcher also asked whether he could purchase creatine or a testosterone booster on his own in the store. Again, the ability to purchase creatine or a testosterone booster without a parent or adult guardian was asked about in separate questions, and the sales attendant's responses to both questions were documented.

This study protocol was approved by the IRB at North Shore-Long Island Jewish Health System. Our application to the IRB acknowledged the fact that the protocol required elements of deception and that informed consent could therefore not be obtained from respondents. Protocol modifications were required by the IRB to ensure that all respondents were >18 years of age, that the data would be de-identified with respect to the identity of the retailers, and that New Jersey would be excluded for fear of self-incrimination.

Data Handling and Statistical Analysis

For each retail store location, data for creatine and testosterone boosters were documented separately. If a sales attendant recommended not using a supplement either initially or after prompting, this was recorded as "recommend against." If a sales attendant recommended a supplement after initially asking for any recommendations, this was recorded as "recommend without prompting." If a sales

TABLE 1 Telephone Recommendations Regarding Creatine and Testosterone Boosters

		Testosterone Booster				Total (Creatine)
		Recommend Without Prompt ^a	Recommend After Prompt	Recommended Against	Refused to Make Recommendation Over the Phone	
Creatine	Recommend without prompt	0	15	78	1	94
	Recommend after prompt	1	6	63	0	70
	Recommended against	1	1	72	0	74
	Refused to make recommendation over the phone	0	0	3	3	6
Total (testosterone booster)		2	22	216	4	244

Recommendations were made by sales attendants at 244 health food stores in the United States to a researcher (MH) posing as a 15-year-old high school sophomore who wants to do strength training in preparation for football.

^a All units are counts of number of sales attendants ($n = 244$).

attendant did not spontaneously suggest a supplement initially, but then recommended it when asked specifically about it, this was recorded as “recommend after prompting.” Sales attendants who refused to make a recommendation over the phone were recorded as “no recommendation offered.”

For both creatine and testosterone boosters, the percentage of sales attendants in each of the 4 response categories detailed above was calculated. The percentage of sales attendants who stated that a 15-year-old could purchase each supplement was also calculated. Responses were analyzed by region (Northeast, South, Midwest, or West), sex of the sales attendant (male or female), and type of store (national chain or nonnational retailer) using a difference in proportions hypothesis test. Results were considered significant at $P < .05$.

RESULTS

A national sample of 244 health food stores that primarily sell dietary supplements was contacted by phone. A total of 77.0% (188/244) of sales attendants contacted were classified as male by the research personnel making the phone calls.

In total, 67.2% of all sales attendants (164/244) recommended creatine for

a 15-year-old boy. A total of 38.5% (94/244) recommended creatine without prompting. An additional 28.7% (70/244) recommended creatine after prompting. A total of 30.3% (74/244) of sale attendants recommended against creatine, whereas 2.5% (6/244) refused to make a recommendation on creatine use over the phone. A total of 74.2% (181/244) of sales attendants stated that a 15-year-old could purchase creatine on his/her own, whereas 22.5% (55/244) stated one had to be ≥ 18 years of age to purchase creatine.

Overall, 9.8% (24/244) of all sales attendants recommended a testosterone booster. Only 2 sales attendants recommended a testosterone booster without prompting, but 9.0% (22/244) recommended one after prompting. A total of 88.5% (216/244) of sales attendants recommended against a testosterone booster, and 1.2% (3/244) refused to make a recommendation over the phone. A total of 41.4% (101/244) stated a 15-year-old could purchase a testosterone booster, and 55.7% (136/244) stated one needed to be ≥ 18 years of age. Reasons given for why a teenager could not purchase one or both of these products included store policy and/or that the product(s) was not recommended for minors.

Table 1 summarizes sales attendants' recommendations for creatine and testosterone boosters. Of the 164 sales attendants who recommended creatine, only 13.4% also recommended testosterone boosters. Twenty-two of the 24 sales attendants who recommended testosterone boosters had also recommended creatine. Of the 2 sales attendants who recommended a testosterone booster without prompting, 1 recommended creatine after prompting and 1 did not recommend creatine.

Although male sales attendants were significantly more likely to recommend creatine without prompting than female sales attendants ($\chi^2 = 7.81, P = .005$), no sex difference was found for creatine recommendation after prompting ($\chi^2 = 0.33, P = .57$). No sex difference was noted for testosterone booster recommendation. No other significant differences were found for either supplement when comparing results by region or store type.

Research personnel noted that in many instances, when asked if the teen caller could purchase either product independently, sales attendants reviewed the labels of the actual products or scanned the products at their checkout counter looking for additional information. Many sales attendants stated that although the label stated the supplement was not recommended for those < 18 years of age, there was no prohibition on a minor purchasing it. One sales attendant said, “It’s not like I’m selling alcohol”; another noted that he is allowed to sell creatine and other weight gain supplements “to a 10-year-old.”

DISCUSSION

Teenagers are often unaware of health risks associated with specific supplements. Research has shown that they rely heavily on information provided by staff

at health food stores.^{4,8} Despite the American Academy of Pediatrics' and the American College of Sports Medicine's recommendations against adolescent use of creatine and testosterone boosters, most health food stores recommended ≥ 1 of these products to a young teenage boy. Specifically, more than two-thirds of sales attendants in this study recommended creatine to a 15-year-old, and nearly 10% recommended a testosterone booster. More than one-third of sales attendants recommended creatine to young customers even without their expressing interest in it. Given that many health food stores claim that their sales attendants are experts in health and wellness products and emphasize the ability of their staff to provide consumer education, it is likely these recommendations will be accepted. Thus, recommendations from sales staff that run counter to product labeling and expert medical opinion pose potentially significant health risks to young teenagers who use creatine and/or testosterone boosters.

Not only are many health food stores making recommendations contrary to expert medical opinion, but pediatricians themselves rarely discuss supplements, such as creatine, with their patients. In a 2001 cross-sectional survey of 37 public high schools in Wisconsin, 12% to 13% of football players reported that their physicians recommended against creatine use, whereas 8% to 9% stated their physicians recommended its use. The large majority of teen athletes either did not discuss creatine use with their physicians, or were neither encouraged nor discouraged from using it.⁴ Without proper counseling by physicians on the risks associated with supplement use, adolescents are likely to continue to use potentially dangerous supplements based on misguided information they receive from health food stores.

Just as health food stores were more likely to recommend creatine for use by teens compared with testosterone boosters, sales staff were far more likely to state that a 15-year-old could purchase creatine than a testosterone booster without an accompanying adult. Although product labels provided by supplement manufacturers often state the products are recommended for use only by adults, it is worth noting that there currently are no legal restrictions limiting sales of these supplements to minors. One sales attendant highlighted this lack of legal restrictions by comparing the sale of dietary supplements to other substances, stating, "It's not like I'm selling alcohol."

The comparison with alcohol is striking because, although state and federal laws regulate the sale of alcohol, cigarettes, and spray paint to minors, no regulation is placed on the sale of dietary supplements to minors. Supplements do not require safety approval by the FDA or other agencies before reaching store shelves, and the process of removing a dangerous supplement from the market is reactionary and delayed.^{18,20} Furthermore, advertisements for supplements often fail to include required disclaimers and, when present, they are "often presented in a hard-to-find way, whether through tiny type or (on television) a fleeting appearance."^{27,28} Inadequate product labeling, in conjunction with the fact that the majority of sales personnel are recommending these products to minors, increases the likelihood that parents and young adolescents will not get accurate information about the safety of these products.

Although the FDA is concerned about the marketing of dietary supplements in general, it does not have the authority (per the 1994 Dietary Supplement Health and Education Act) to approve dietary supplements before they are marketed to consumers. The

FDA can take actions only after a product is on the market in cases where the dietary supplement is adulterated (eg, unsafe), misbranded (eg, misrepresentations are made on the product labeling), or cannot be marketed as a dietary supplement (eg, an unapproved new drug).²⁹ Thus, under its current mandate, the FDA's role with respect to dietary supplements is reactive, not proactive, thereby allowing for unprecedented growth in the development and marketing of these untested products. Because of the limited power of federal regulation, Pomeranz et al²⁰ have suggested that individual states implement more proactive policies to keep children safe, such as imposing minimal age requirements on the purchase of dietary workout supplements similar to those placed on alcohol and cigarettes. Given that annual sales of dietary supplements in the United States have risen sixfold since 1994 from \$5.8 billion to about \$35 billion, greater consideration needs to be given to how these products are labeled and marketed to children and young adolescents.³⁰

CONCLUSIONS

Supplements, such as creatine and testosterone boosters, can pose significant health risks if used by young adolescents. These products are not recommended by some product manufacturers for anyone <18 years of age and should elicit warnings from medical professionals for individuals of any age due to the minimal regulation and safety screening for supplements. Yet, there are no legal restrictions at present limiting the sale of these products to minors. Of greater concern, these products are often being recommended to young teen athletes by the "product experts" at health food stores. Although these stores, like all retailers, are profit-conscious, they should give serious consideration

to revising their policies regarding recommending products like these to minors. This is especially true for the national retail chains, given their professed expertise and stated concern for consumer health and safety. Simple solutions could include improving the knowledge of their staff about supplements not recommended for youth, enabling their point-of-sale software to caution about use of these

products by minors, and conducting audits to verify compliance with these policies. Furthermore, although the Massachusetts and New Jersey bills mentioned above that would have restricted the sale of creatine and other supplements to minors both failed to gain the power of law, states should consider introducing and passing similar legislation to address this problem. Until additional

safeguards are introduced by retailers, states, or the FDA, pediatricians should counsel all adolescents, not just teen athletes, about the risks associated with supplement use.

ABBREVIATIONS

FDA: Food and Drug Administration

IRB: institutional review board

Address correspondence to Ruth Milanaik, DO, Division of Developmental and Behavioral Pediatrics, Steven and Alexandra Cohen Children's Medical Center of New York, 1983 Marcus Ave, Suite 130, Lake Success, NY 11042. E-mail: rmilanaik@northwell.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2017 by the American Academy of Pediatrics

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: No external funding.

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

REFERENCES

1. Raudenbush B, Meyer B. Muscular dissatisfaction and supplement use among male intercollegiate athletes. *J Sport Exerc Psychol*. 2003;25(2):161–170
2. Alves C, Lima RVB. Dietary supplement use by adolescents. *J Pediatr (Rio J)*. 2009;85(4):287–294
3. Field AE, Austin SB, Camargo CA Jr, et al. Exposure to the mass media, body shape concerns, and use of supplements to improve weight and shape among male and female adolescents. *Pediatrics*. 2005;116(2). Available at: www.pediatrics.org/cgi/content/full/116/2/e214
4. Eisenberg ME, Wall M, Neumark-Sztainer D. Muscle-enhancing behaviors among adolescent girls and boys. *Pediatrics*. 2012;130(6):1019–1026
5. Calzo JP, Sonnevile KR, Scherer EA, Jackson B, Austin SB. Gender conformity and use of laxatives and muscle-building products in adolescents and young adults. *Pediatrics*. 2016;138(2):e20154073
6. McGuine TA, Sullivan JC, Bernhardt DT. Creatine supplementation in high school football players. *Clin J Sport Med*. 2001;11(4):247–253
7. Metzl JD, Small E, Levine SR, Gershel JC. Creatine use among young athletes. *Pediatrics*. 2001;108(2):421–425
8. Smith J, Dahm DL. Creatine use among a select population of high school athletes. *Mayo Clin Proc*. 2000;75(12):1257–1263
9. Kayton S, Cullen RW, Memken JA, Rutter R. Supplementation and ergogenic aid use by competitive male and female high school athletes. *Med Sci Sports Exerc*. 2002;34(5):S193
10. Gomez J; American Academy of Pediatrics Committee on Sports Medicine and Fitness. Use of performance-enhancing substances. *Pediatrics*. 2005;115(4):1103–1106
11. Terjung RL, Clarkson P, Eichner ER, et al; American College of Sports Medicine. American College of Sports Medicine roundtable. The physiological and health effects of oral creatine supplementation. *Med Sci Sports Exerc*. 2000;32(3):706–717
12. Grunewald KK, Bailey RS. Commercially marketed supplements for bodybuilding athletes. *Sports Med*. 1993;15(2):90–103
13. Calfee R, Fadale P. Popular ergogenic drugs and supplements in young athletes. *Pediatrics*. 2006;117(3). Available at: www.pediatrics.org/cgi/content/full/117/3/e577
14. Laos C, Metzl JD. Performance-enhancing drug use in young athletes. *Adolesc Med Clin*. 2006;17(3):719–731, abstract xii
15. Souza RA, Miranda H, Xavier M, et al. Effects of high-dose creatine supplementation on kidney and liver responses in sedentary and exercised rats. *J Sports Sci Med*. 2009;8(4):672–681
16. Lopez RM, Casa DJ, McDermott BP, Ganio MS, Armstrong LE, Maresh CM. Does creatine supplementation hinder exercise heat tolerance or hydration status? A systematic review with meta-analyses. *J Athl Train*. 2009;44(2):215–223
17. Hile AM, Anderson JM, Fiala KA, Stevenson JH, Casa DJ, Maresh CM. Creatine supplementation and anterior compartment pressure during exercise in the heat in dehydrated men. *J Athl Train*. 2006;41(1):30–35
18. Rodriguez NR, Di Marco NM, Langley S; American Dietetic Association; Dietitians of Canada; American College of Sports Medicine. American College of Sports Medicine position stand. Nutrition and athletic

- performance. *Med Sci Sports Exerc.* 2009;41(3):709–731
19. Cohen PA. Hazards of hindsight--monitoring the safety of nutritional supplements. *N Engl J Med.* 2014;370(14):1277–1280
 20. Pomeranz JL, Barbosa G, Killian C, Austin SB. The dangerous mix of adolescents and dietary supplements for weight loss and muscle building: legal strategies for state action. *J Public Health Manag Pract.* 2015;21(5):496–503
 21. Lattavo A, Kopperud A, Rogers PD. Creatine and other supplements. *Pediatr Clin North Am.* 2007;54(4):735–760, xi
 22. Rhoden EL, Morgentaler A. Risks of testosterone-replacement therapy and recommendations for monitoring. *N Engl J Med.* 2004;350(5):482–492
 23. Willoughby DS, Spillane M, Schwarz N. Heavy resistance training and supplementation with the alleged testosterone booster Nmda has no effect on body composition, muscle performance, and serum hormones associated with the hypothalamo-pituitary-gonadal axis in resistance-trained males. *J Sports Sci Med.* 2014;13(1):192–199
 24. Ahrendt DM. Ergogenic aids: counseling the athlete. *Am Fam Physician.* 2001;63(5):913–922
 25. Giorgi A, Weatherby RP, Murphy PW. Muscular strength, body composition and health responses to the use of testosterone enanthate: a double blind study. *J Sci Med Sport.* 1999;2(4):341–355
 26. GNC. GNC sales associate, retail part time in New York, NY. Available at: <http://gnc.jobs/new-york-ny/sales-associate-retail-part-time/FC3E8B47A17E44CFA7231F51B5341DFE/job/>. Accessed February 10, 2016
 27. Giasone F. The Vitamin Shoppe opens its doors on route 23. *Patch.* August 11, 2011. Available at: <http://patch.com/new-jersey/triboro/the-vitamin-shoppe-opens-its-doors-on-route-23>. Accessed February 10, 2016
 28. Morris CA, Avorn J. Internet marketing of herbal products. *JAMA.* 2003;290(11):1505–1509
 29. Kesselheim AS, Connolly J, Rogers J, Avorn J. Mandatory disclaimers on dietary supplements do not reliably communicate the intended issues. *Health Aff (Millwood).* 2015;34(3):438–446
 30. Ostroff S. Making progress in protecting consumers from unsafe supplements. Available at: <http://blogs.fda.gov/fdavoices/index.php/2016/01/making-progress-in-protecting-consumers-from-unsafe-supplements/>. Accessed January 22, 2016