

# Hazards of Dietary Supplement Use

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## OBJECTIVES

1. Summarize the various types of ergogenic aids.
2. Summarize the known adverse effects of the most commonly used dietary supplement as identified in the study.
3. Identify the major sources of information cited by Soldiers prior to consuming dietary supplements according to the study.

## ABSTRACT

**Introduction:** An ergogenic aid is any agent used to enhance energy production and/or utilization with the intent to improve performance in a particular sport or activity. Dietary supplements are consumed for their potential ergogenic effects by Soldiers seeking to improve physical performance. However, these agents are not regulated by the United States Food and Drug Administration (FDA). The long-term health effects of these unregulated dietary supplements are unknown. The purpose of this study is to establish the incidence of dietary supplement use in a U.S. Army combat unit and to present a brief review of the literature on the documented adverse reactions related to dietary supplements use. **Methods:** 750 Rangers from the U.S. Army 1st Ranger Battalion were administered an anonymous, self-reported, survey concerning recreational and competitive athletic participation, participation in weight training, ergogenic supplement use, and sources of nutritional information. All surveys were administered by the battalion surgeon. The data was analyzed using the Pearson's Chi-square with continuity correction method of analysis. **Results:** 294 Rangers (39.5%) completed the questionnaire. One hundred and nine (37%) of the responders admitted to using at least one dietary supplement. The average age of the respondent was 23 years. Dietary supplement use was associated with participation in recreational athletics and weight training. Protein supplements were the most common supplement, followed by creatine and thermogenics respectively. Less than 1% used anabolic steroids. The most commonly cited source for nutritional information concerning ergogenic supplements is another Soldier, followed closely by fitness magazines. Less than 10% cited the unit surgeon or local nutritionist. **Conclusions:** Dietary supplement use in the surveyed unit is similar to rates reported for other athletic organizations. As the long-term health effects are unknown, the decision to consume dietary supplements should be carefully deliberated. Unit surgeons are uniquely situated to advise these Soldiers.

	Example
Mechanical	<ul style="list-style-type: none"><li>• Light weight orthotics</li><li>• Custom Footwear</li></ul>
Psychological	<ul style="list-style-type: none"><li>• USMA Center for Performance Enhancement<sup>2</sup></li></ul>
Physiological	<ul style="list-style-type: none"><li>• U.S. Army World Class Athlete Program<sup>3</sup></li><li>• U.S. Olympic Training Center<sup>3</sup></li></ul>
Pharmaceutical	<ul style="list-style-type: none"><li>• Prescription stimulants<sup>4</sup></li></ul>
Neutraceutical	<ul style="list-style-type: none"><li>• Dietary supplements</li></ul>

Table 1. Summary table of types of ergogenic aids used by the U.S. military.

## INTRODUCTION

An ergogenic aid is any agent used to enhance energy production and/or utilization.<sup>1</sup> These agents are used to enhance performance in a particular sport or activity. Use of ergogenic aids in the U.S. military is not new. (Table 1)

Nutraceutical or dietary supplement use by athletes has received appreciable attention recently.<sup>3,5-10</sup> However, dietary supplement users vary across a wide spectrum.<sup>1,6,11-19</sup> Nor is the use of nutraceuticals limited to purely athletic endeavors. Many novel nutraceutical therapeutic strategies have been reported in the treatment in the various disorders to include: pediatric irritable bowel syndrome,<sup>20</sup> ulcerative colitis,<sup>2</sup> osteoarthritis,<sup>22-23</sup> and pain management.<sup>24</sup>

The myriad uses for dietary supplements has added to the confusion regarding the efficacy and, more importantly, the safety of over-the-counter dietary supplements consumed by the general public.<sup>25</sup> The Dietary Supplement and Health Education Act in 1994 was enacted, in part, to standardize the manufacture and marketing of dietary supplements.<sup>26</sup>

The ability to enhance physical performance is as attractive to Soldiers as their competitive amateur or professional athlete counterparts. The Committee on Military Nutrition Research recommended the further study of nutritional supplementation for the military, especially the forward deployed personnel.<sup>27</sup> However, the incidence of dietary supplement use in the active duty population is not known. The purpose of this study is to establish the incidence of dietary supplement use in a U.S. Army combat unit and to present a review of the literature on the documented adverse reactions related to dietary supplements use.

## METHODS

After appropriate IRB approval, 750 active duty service members assigned to the U.S. Army 1st Ranger Battalion were administered an anonymous, two-page, self-response survey under the supervision of the Ranger Battalion Surgeon during a one week period from July – August 1999. The survey was modeled after similar surveys used by the National Collegiate Athletic Association.<sup>7</sup> Random error was controlled by using the single intake model which minimized day to day variability and the large sample size. Systemic error, chiefly in the form of under-reporting, was anticipated. The questionnaire was a qualitative, rather, than quantitative survey.

We collected data on age, participation in competitive athletics, participation in recreational athletics, participation in weight training, ergogenic use, type of agent used, as well as the sources of informa-

tion on nutrition and supplements. Participation in the different types of exercise by users vs. non-users of dietary supplements was compared with a 2x2 contingency test (Pearson's Chi Square with continuity correction). Ninety-five percent confidence intervals (95% CI) were calculated for the frequency of competitive athletics and weight training in the supplement users using the modified Wald equation as there were fewer than five who did not participate in those forms of exercise. Age between users vs. non-users of dietary supplements was compared with a Mann-Whitney rank sum test.

## RESULTS

Of the 750 Soldiers, 39.2% responded to the survey. Reasons for non-participation were: (1) time constraints due to the high operational tempo of the surveyed unit, (2) training, (3) leave. Of the 294 Rangers responding to the survey, 37% (n=109) admitted to using dietary supplements. The average age of the dietary supplement user, as well as the non-user, was 23 years. There was no significant difference in age between users and non-users ( $p > 0.05$ ). There was no significant difference in participation in competitive athletics between users and non-users ( $p > 0.05$ ). More users (89.9%) than non-users (71.4%) participated in recreational athletics. There was a significant difference in participation in recreational athletics between users and non-users ( $p < 0.001$ ). There was a significant difference in participation in weight training between users and non-users ( $p = 0.001$ ). More users (96.3%) than non-users (82.2%) participated in weight training. (Figure 1) The vast majority of Rangers had participated in competitive athletics (96.3% of supplement users vs. 92.4% of non-users). This difference in competitive athletic participation was not significant ( $p < 0.80$ ).

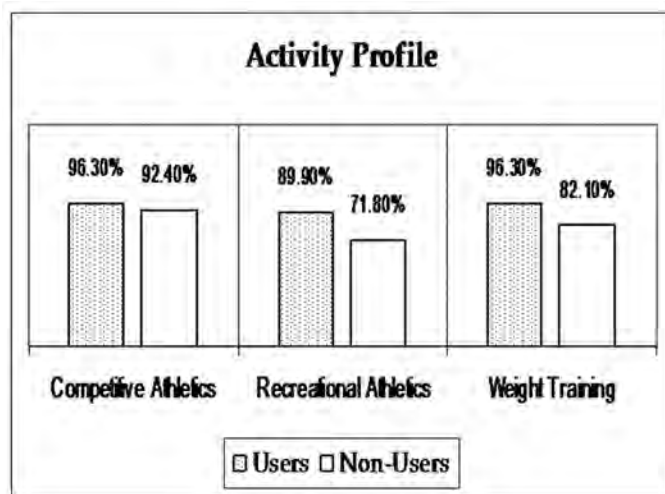
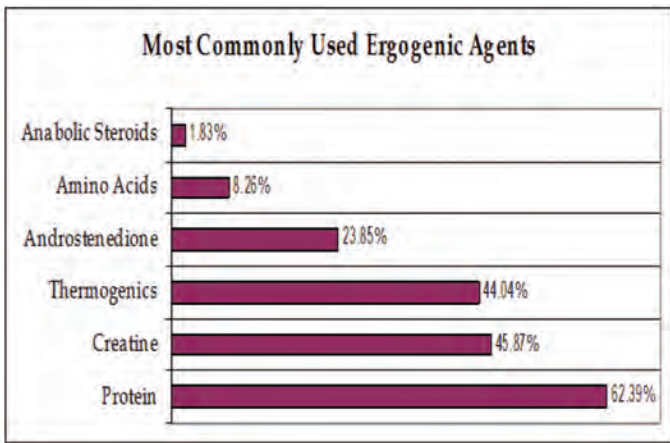


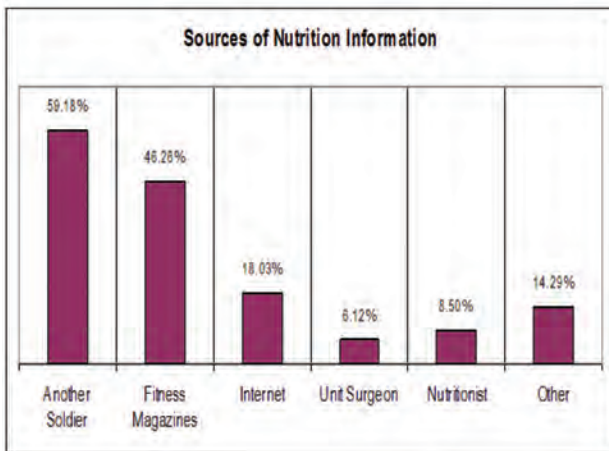
Figure 1. Graphical depiction of the participation rates in competitive and recreational athletics events as well as regular weight training between ergogenic supplement users and non-users.



**Figure 2.** Chart depicting the most commonly used ergogenic aids. Thermogenics include herbal products whose main active ingredients are caffeine, ephedra, Mahung, etc.

The most commonly used dietary supplement was whole protein supplements such as whey protein; used by 62.3% of the dietary supplement users. (**Figure 2**) Creatine and thermogenics were used by 45.8% and 44% of the users respectively. Anabolic steroids used was reported by less than 2% of the users (n=2).

Other Soldiers were the most commonly cited reference for their nutrition information, used by 59% of the Soldiers overall. (**Figure 3**) Fitness magazines were a close second (46%), followed by the internet (18%). The unit surgeon was the least cited source of information at 6% followed by nutritionist at 8%.



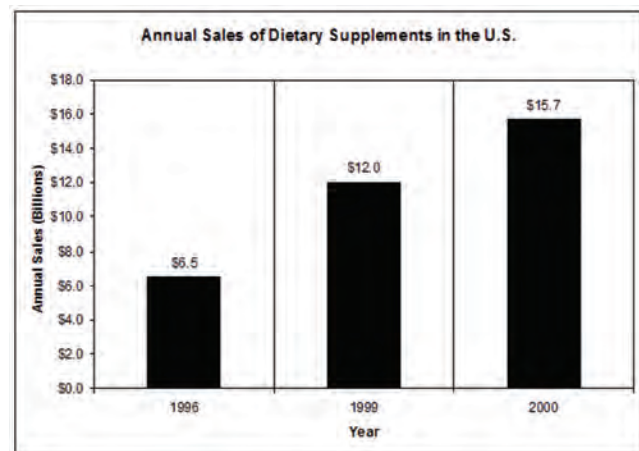
**Figure 3.** Graphical depiction of the common sources of product information cited by the Rangers. Other includes personal trainer and medical journals.

## DISCUSSION

The dietary supplement industry is a multi-billion dollar industry.<sup>18,26,28</sup> (**Figure 4**) The marketing of dietary supplements is mostly based on generalized, scientifically unproven claims.<sup>3,26</sup> It has been estimated

that 89 brands of supplements currently exist offering over 300 products. Over 78% of these products claim to contain unique ingredients that promise various results loosely based on science. Only 59% of the 235 unique ingredients found in the products being advertised have any toxicological data on file.<sup>57</sup> The long-term health effects of these products have not been methodically evaluated. However, as dietary supplements are not marketed for the purpose of treating any ailment, they are considered food products. Thus they are not under the same high level of scrutiny of the Food and Drug Administration provided to products designated as medications.<sup>5,26,58</sup> In documented cases of adverse side effects associated with dietary supplement use, the burden of proof rests with the government and not with the manufacturer to demonstrate a causative link.<sup>59-61</sup> However, several authors have reported adverse outcomes associated with dietary supplement use. (**Table 2**) For this reason, the major athletic governing bodies (International Olympic Committee (IOC), National Collegiate Athletic Association (NCAA), and Amateur Athletic Union (AAU)) have banned or strictly govern dietary supplement use. Until the efficacy, safety, and long-term health effects of these substances can be firmly established, care should be used with dietary supplement use.

Our data supports that the Soldiers participating in this survey consume ergogenic supplements at rates similar to other athletic populations.<sup>1,5,58,66,67</sup> (**Table 3**) Our results are also in line with the literature in that supplement use is inversely correlated to nutritional knowledge.<sup>68-70</sup> Other athletes and fitness magazines (whose profits are partially generated by dietary supplement advertisements) are the most common source of information cited by amateur athletes.<sup>57</sup>



**Figure 4.** Graphical depiction of annual sales growth of dietary supplements in the United States.<sup>18,26, 28</sup>

**Table 2.** Review of documented adverse effects and the top selling dietary supplement brands sold in the U.S.<sup>56</sup>

AGENT	ACTIVE INGREDIENT(S)	TRADE NAMES	DOCUMENTED ADVERSE EFFECTS
Creatine	<ul style="list-style-type: none"> <li>• Creatine Monohydrate</li> </ul>	<ul style="list-style-type: none"> <li>• Creatine Fuel Chews (Twinlab Inc. NY, NY)</li> <li>• Creatine Monohydrate 100% (Higher Power, Boise, ID)</li> <li>• Cell Tech (MuscleTech, Mississauga, Canada)</li> <li>• Micronized Creatine (AST Sports Science, Golden, CO)</li> </ul>	<ul style="list-style-type: none"> <li>• Electrolyte disturbances<sup>29-31</sup></li> <li>• Renal Damage<sup>29,32</sup></li> <li>• Transient elevation in transaminase<sup>31,33</sup></li> <li>• Increased post-exercise compartment pressures<sup>34-35</sup></li> </ul>
Amphetamine Derivatives	<ul style="list-style-type: none"> <li>• Ephedrine</li> <li>• Pseudoephedrine</li> <li>• Phenylpropanolamine</li> <li>• Phenteramine</li> <li>• Ma-Huang</li> </ul>	<ul style="list-style-type: none"> <li>• Hydroxycut (MuscleTech, Mississauga, Canada)</li> <li>• Muscle Milk (CytoSport, Benicia, CA)</li> <li>• Ripped Fuel (Twinlab Inc. NY, NY)</li> <li>• ProBURN (Prolab, Chatsworth, Ca)</li> </ul>	<ul style="list-style-type: none"> <li>• Acute Myocardial Infarction<sup>36-37</sup></li> <li>• Arrhythmias<sup>36-39</sup></li> <li>• Myocarditis<sup>36,37</sup></li> <li>• Severe Hypertension<sup>36</sup></li> <li>• Stroke<sup>40</sup></li> <li>• Hyperthermia<sup>41</sup></li> <li>• Rhabdomyolysis<sup>41</sup></li> </ul>
Chromium	<ul style="list-style-type: none"> <li>• Chromium Picolinate</li> </ul>	<ul style="list-style-type: none"> <li>• Higher Power Chromium Picolinate (Higher Power, Boise, ID)</li> <li>• Optimum Chromium Picolinate (Optimum Nutrition, Aurora, IL)</li> <li>• AdvaLean (Advanced Performance Nutraceuticals, Denver, CO)</li> <li>• Chromic Fuel (Twinlab, NY, NY)</li> <li>• Ripped Fast (Universal Nutrition, New Brunswick, NJ)</li> </ul>	<ul style="list-style-type: none"> <li>• Transient decrease renal function<sup>42</sup></li> <li>• Transient decrease hepatic function<sup>42</sup></li> <li>• Possible disposition to iron deficiency anemia<sup>43</sup></li> </ul>
Protein		<ul style="list-style-type: none"> <li>• Optimum 100% Whey Protein (Optimum Nutrition, Aurora, IL)</li> <li>• N-Large II (Prolab, Chatsworth, Ca)</li> <li>• Myoplex (EAS Inc, Golden, CO)</li> <li>• NitroSyn Protein (I Force Nutrition, South Windsor, CT)</li> <li>• Nitro-Tech (MuscleTech, Mississauga, Canada)</li> </ul>	<ul style="list-style-type: none"> <li>• Dehydration<sup>44-45</sup></li> <li>• Exacerbation of gout<sup>44-45</sup></li> <li>• Decreased calcium stores<sup>44-46</sup></li> <li>• Decreased renal function<sup>44-45</sup></li> <li>• Decreased hepatic function<sup>44-45</sup></li> </ul>

**Table 2** continued. Review of documented adverse effects and the top selling dietary supplement brands sold in the U.S.<sup>56</sup>

AGENT	ACTIVE INGREDIENT(S)	TRADE NAMES	DOCUMENTED ADVERSE EFFECTS
Amino Acids		<ul style="list-style-type: none"> <li>• Animal Nitro (Universal Nutrition, New Brunswick, NJ)</li> <li>• Amino 2222 Tabs (Optimum Nutrition, Aurora, IL)</li> <li>• Amino Fuel (Twinlab, NY, NY)</li> <li>• Amino 2000 (Prolab, Chatsworth, Ca)</li> </ul>	<ul style="list-style-type: none"> <li>• Dehydration<sup>44-45</sup></li> <li>• Exacerbation of gout<sup>44-45</sup></li> <li>• Decreased calcium stores<sup>44-45</sup></li> <li>• Decreased renal function<sup>44-45</sup></li> <li>• Decreased hepatic function<sup>44-45</sup></li> </ul>
Androstenedione		<ul style="list-style-type: none"> <li>• 19-Nor Androstack II (SciFit Nutrition, Oakmont, PA)</li> <li>• Priobolan Acetate (Promatrix, Franklin, NJ)</li> <li>• Anabolic Complex (TKE Fitness, Corinth, MS)</li> <li>• Maximum Testosterone (Maximum International, Deerfield Beach, FL)</li> <li>• Androblast (Medlean, Duxbury, MA)</li> </ul>	<ul style="list-style-type: none"> <li>• Atherosclerosis<sup>47-48</sup></li> <li>• Priapism<sup>49</sup></li> <li>• Positive urine screen for anabolic steroids<sup>32</sup></li> <li>• Gynecomastia<sup>50</sup></li> <li>• Premature physeal arrest<sup>50-51</sup></li> <li>• Decreased HDL<sup>49</sup></li> <li>• Prostate hypertrophy<sup>52-53</sup></li> <li>• Increased testosterone production in females<sup>54</sup></li> <li>• Increased estrogen production in males<sup>55</sup></li> </ul>

**Table 3.** Tabular review of dietary supplement use in the U.S. athletic population.

<i>Review of Dietary Supplement use by the U.S. Athletic Population</i>
13% of 8th grade students admit to dietary supplement use <sup>14</sup>
30% of high school football players use creatine <sup>62</sup>
71% of NCAA Division 1 football players use creatine <sup>16</sup>
22% of high school athletes admit to use of current or recent use of dietary supplements <sup>63</sup>
34% of competitors at the 2000 Summer Olympic games used dietary supplements <sup>64</sup>
38% of female and 29% of male competitors who admitted to dietary supplement use also used herbal supplements <sup>26</sup>
92% of female and 90% of male athletes on the U.S. 2000 Summer Olympic Team used some form of dietary supplements <sup>65</sup>
Some athletes participating in 2000 Summer Olympic Games admitted to using 18 to 20 different dietary supplements <sup>18</sup>

A major limitation of our study is the low response rate. The low response rate suggests a level of systematic error as this may have been a result of self-exclusion of Soldiers with higher usage in a form of under-reporting as well as an identification bias.<sup>71-74</sup> However, no statistical method can fully correct reporting deficiencies, and some studies suggest such efforts may confound the findings.<sup>75</sup>

We attempted to control other known biases. Recall bias was limited in the usage of yes or no questions rather than quantification of the supplements consumed. Also, the surveys were administered anonymously in order to minimize the social desirability bias. After a pre-survey block of instruction, the unit surgeon stepped out of the room, no personal identification data was solicited, and the surveys were placed into a box as the participants exited the room. The proctor was available to answer questions as necessary. The other factors identified for the low response rate can be directly related to the unit's high operational tempo. As a result, our survey effectively surveyed the Soldiers in the recuperative phase of the training cycle. A study of the Soldiers in the active phase of the training cycle may reveal a different pattern of supplement use. Since the goal of supplement use is to optimize performance in demanding situations, further study in this area is warranted. While our goal is to establish the usage rates of dietary supplements in this U. S. Army unit, each military unit has its own inherently unique culture. Similar studies in different sub-populations to include combat support and service support units as well as our sister services are required.

## CONCLUSIONS

The use of various forms of ergogenic aids is not new to the U.S. military. Dietary supplements, however promising, are promoted based on loose science and marketed with little scrutiny. There is legitimate reason for concern for caregivers of dietary supplement users as the long-term health effects of these compounds are unknown, use of supplements is inversely correlated with nutritional knowledge, and knowledgeable sources are the least utilized resource of information for supplement use. Dietary supplements complicate peri-operative considerations.<sup>75-76</sup> Supplements also pose preventative medicine issues as there is a tendency for supplement users to partake in other high risk behaviors.<sup>28</sup> Active duty personnel, especially elite ground troops, are attracted to dietary supplements at rates similar to competitive athletes. Further study in this field is necessary.

The unit surgeon, as the chief advisor to the unit commander for healthcare issues and the most readily

available medical professional to the Soldiers, is uniquely situated to best counsel our Soldiers on the potential hazards of dietary ergogenic supplement use but is an under-utilized resource according to our study. Unit surgeons should familiarize themselves with the various forms of dietary supplements available so that they advise the troops accordingly.

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