# A Game of Inches

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*Writing 20 (Spring 2007): Arguing about Diet and Dieting*
*Professor Cary Moskovitz*

*In order to thrive in the competitive realm of sports, ancient Greek Olympians believed they could gain the competitive edge by gorging on mushrooms. Today's athletes are consuming a less extreme, yet still worrisome substance:* ***creatine.*** *Do the rewards outweigh the risks?*

Writing classes are designed to teach you how to write a paper that not only flows like silk curtains but holds a reader's attention like the season finale of "24." However, scientific writing as a genre is not especially known for either of those qualities, nor are papers co-written by four college students with very different schedules and especially different writing styles. In his Writing 20 course, Arguing about Diet and Dieting, Dr. Cary Moskovitz presented us, his students, with both of these challenging criteria for our final commentary. Furthermore, we were expected to produce better quality writing than students in any other section of the writing program. Clearly, we had a lot of work ahead of us. Compromises may be the core of any successful group project, but trying to achieve a group consensus on a topic, eventually "protein supplementation", stymied our class. Even within our groups of four, we argued constantly over a specific research topic, proving ▶

*A small number of short-term (<3 week) studies have shown that creatine boosts performance in high-intensity, short duration (HISD) activities.*

Creatine, an amino acid derivative that has been traditionally found in meats and fishes, has become ubiquitously available in over-the-counter supplements purchased by athletes and others seeking muscle growth, boosts of energy, and performance enhancement[1]. Endorsements made by professional athletes like Mark McGwire led to the enormous success of creatine products[2]. In 2001, the creatine supplement market in the United States was estimated at $400 million[3] and it continues to increase[4]. Its accessibility has led to a wide variety of athletic users, from aspiring teenage exercisers to professional athletes. In 2001, 28 percent of college athletes regularly supplemented their diets with creatine products[5].

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Most users share these key desires: increased muscle mass and enhanced athletic performance, because in sports, every inch counts. However, it is plausible that the most commonly observed effect, increased lean mass, is only due to water retention, not to muscle fiber growth. No long-term studies have been done that could show strong evidence of hazards from creatine supplementation, thus there has been little critical evaluation of its health implications. However, anecdotal reports of injury are prevalent enough to raise questions about its safety. We feel that under this cloud of uncertainty, healthcare professionals should not recommend creatine supplementation to athletes seeking physical enhancement.

## Benefits

While there is no scientific consensus on the improvements caused by creatine supplementation, a small number of short-term (<3 week) studies have shown that creatine boosts performance in high-intensity, short duration (HISD) activities, including cycling, jumping, and weightlifting[1]. In a highly cited report, the strength of 25 NCAA Division 1A football players was tested prior to and after creatine supplementation and their dietary intakes were monitored daily[6]. The authors claim creatine supplementation improved strength and in-game performance. Another study found that seven days of creatine supplementation enhanced muscular performance for bench press and jump squat workouts in young active men, correlating with the ability to complete workouts at a higher intensity[7]. Furthermore, creatine has been claimed to help improve endurance by increasing time to fatigue. Burke et al. indicate that subjects consuming 7.7 g/day of creatine for 21 days in a double-

blinded experiment performed more total work until fatigue, and were able to maintain higher mean peak power for longer periods of time, compared with those who did not receive creatine[8]. In addition to factors affecting physical performance, there is some evidence in the literature that creatine supplementation improves the overall health of an athlete by decreasing LDL levels[9], removing aqueous radical and reactive species ions as an antioxidant[10], and preventing the breakdown of muscle tissue during times of high stress[11].

Even though the aforementioned research shows creatine's possible positive effects on strength, endurance, and overall health after HISD exercises, multiple studies conducted in conjunction with other types of exercise have shown no elevation over baseline in these areas[12, 13, 14, 15]. This could mean that creatine only enhances performance when coupled with HISD exercise. Yet, even some studies conducted using HISD exercise showed equivocal results[16, 17, 18]. The disparity amongst results suggests that either there were significant difference in research methodologies or in the kinds of subjects tested. For instance, researchers may not have properly accounted for the creatine content produced naturally in the athletes' bodies. Burke et al.'s research only recorded the levels of creatine consumed as supplements, neglecting any creatine the subjects may have consumed naturally in their foods (for example tuna or beef). Thus, there is a chance that some foods could have naturally boosted subjects' creatine levels, making diet a possible confounding variable[8]. In addition, creatine accumulation varies between individuals and different athletes might produce more creatine naturally and not need supplementation to maintain creatine levels. Overall, it is impossible to determine what exactly creatine provides to any given athlete, because there have been no long term or large studies on the impacts of creatine.

One of creatine's widely-believed effects is that it quickly increases lean mass for those that take it[19]. In 2000 the journal *Medicine and Science in Sports and Exercise* published a report that indicated consuming creatine supplements enhances gains of fat free mass[19]. The analysis, which was peer reviewed, referenced hundreds of studies. Nevertheless, the gain of fat-free mass may not be as beneficial as it seems. A study done by the Department of Physical Education and Athletic Training at Palm Beach Atlantic University in 2000 tested the effect of creatine on body weight[20]. This study showed that 17 male participants gained, on average, about two liters (2 kilograms) of water due to creatine supplementation by the end of four weeks of treatment ($p = 0.05$). This bloating effect could reinforce the perception that creatine makes an athlete stronger and more muscular when it is actually only causing water retention. In other words, this so called increase in lean mass may be nothing more than simple water retention.

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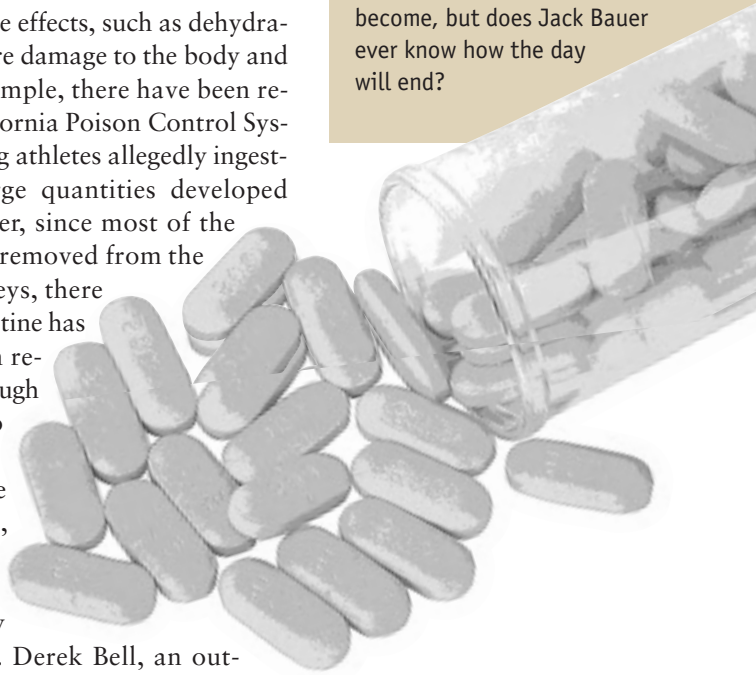
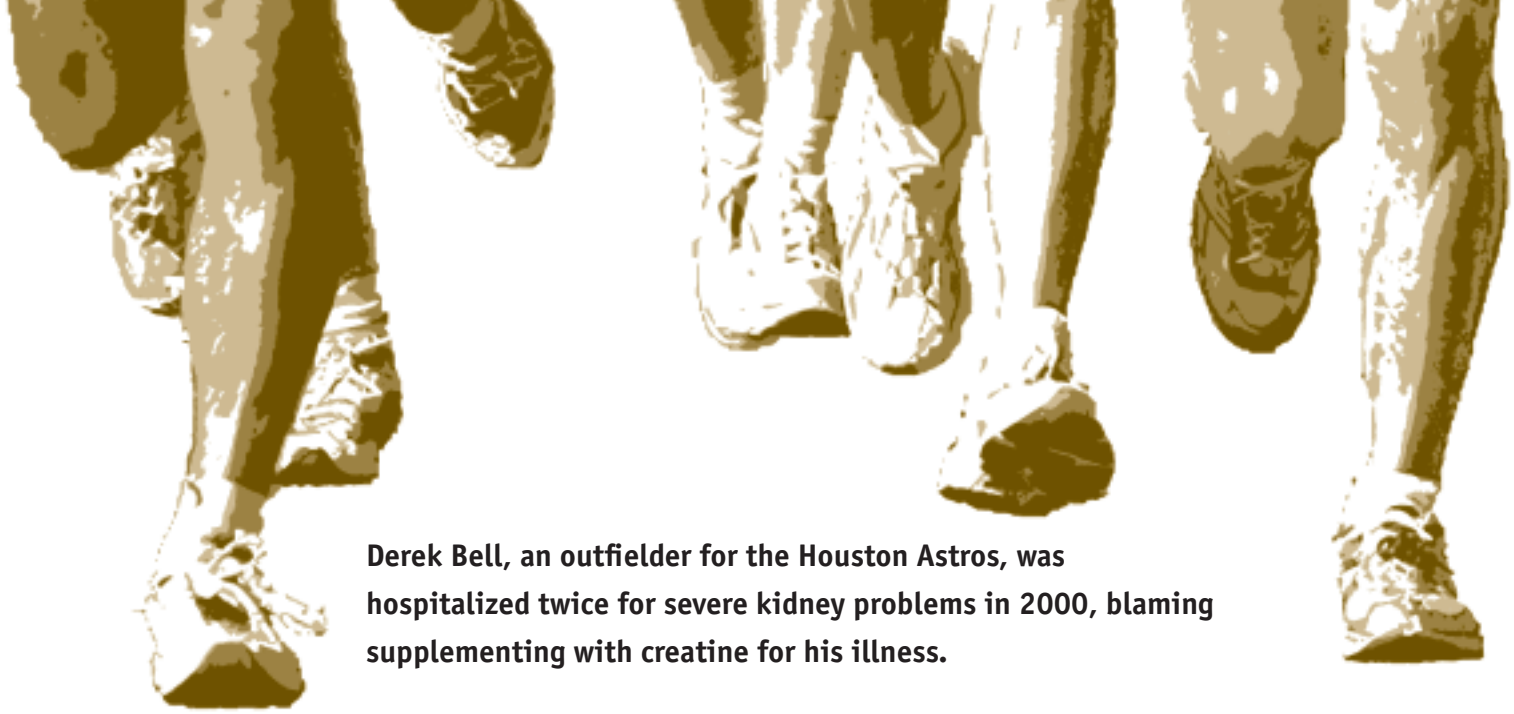
## Adverse Effects

In addition to the fact that creatine may not aid athletic performance, the negative impacts of supplementation should also be considered. Creatine, like most other supplements, has some side effects that make its use a risk. The most frequently reported adverse side effects of creatine supplementation include gastrointestinal distress, muscle cramps, muscle strains, dehydration, and heat intolerance[21]. In addition, creatine has been associated on rare occasions with rash, dyspnea, vomiting, diarrhea, nervousness, anxiety, fatigue, migraines, myopathy, polymyositis, seizures, and atrial fibrillation[22].

Some of these side effects, such as dehydration, can cause severe damage to the body and even death. For example, there have been reports from the California Poison Control System that some young athletes allegedly ingesting creatine in large quantities developed seizures[22]. Moreover, since most of the creatine ingested is removed from the plasma by the kidneys, there are worries that creatine has an adverse effect on renal function[22]. Although studies document no causal relationship between creatine use and renal failure, high profile cases in the media suggest that they may be causally related. Derek Bell, an outfielder for the Houston Astros, was hospitalized twice for severe kidney problems in

that Dr. Moskovitz had certainly chosen his class title correctly and that perhaps we should have taken it more literally when scheduling our courses. Ultimately, after much debate and disagreement, our group of four chose to write about the controversial debate over creatine. We figured that if we were going to spend months researching one thing, it might as well be filled with scandal and risky business. We are but teenagers, after all. Choosing the topic was only the tip of the iceberg, though. Imagine it: four overachieving Duke students trusting each other enough with their grade to write a single paper together? That's hard to find, especially fresh out of high school where we were used to working best alone. We still fought through this foreign experience, though, out of necessity and obsessive concern for our GPAs. The following paper was unexpected, a final draft that only barely resembles the first. We had no idea what it would become, but does Jack Bauer ever know how the day will end?





**Derek Bell, an outfielder for the Houston Astros, was hospitalized twice for severe kidney problems in 2000, blaming supplementing with creatine for his illness.**

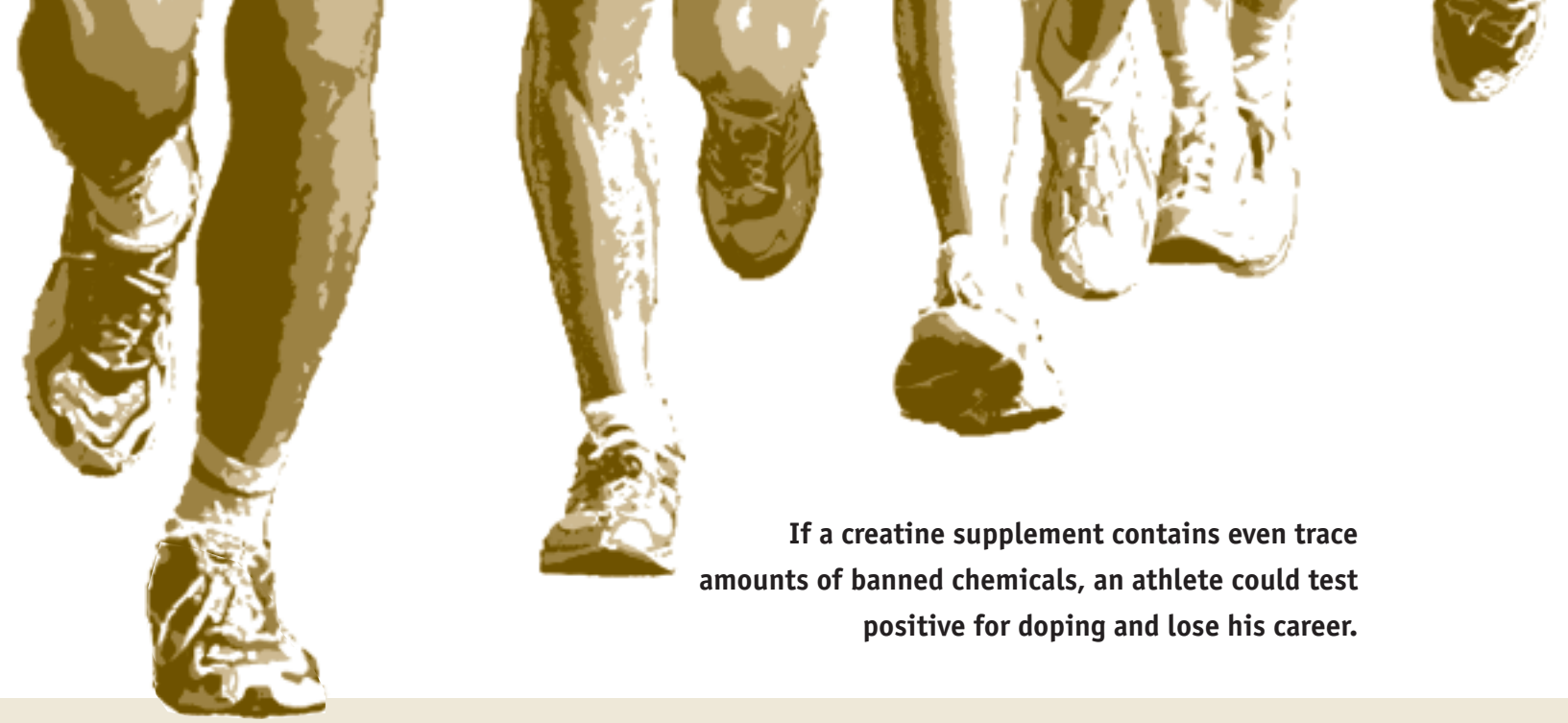
2000, blaming supplementing with creatine for his illness[23]. After cessation of supplementation, his condition improved. It was later revealed that he did not take the creatine with water as recommended, thus becoming dehydrated. In this case and others, the renal failure may have resulted from dehydration, not directly from creatine use.

Yet, just as with the benefits, there are studies countering the risks of creatine supplementation. Most reports of adverse effects are anecdotal and may be linked to improperly ingesting higher-than-recommended doses. The validity of the renal failure claim was called into question in a study conducted by Poortmans and Francaux in association with the European College of Sport Science[24]. Researchers tested nine healthy athletes in track and field and volleyball that self-supplemented with creatine. The athletes took 1 to 20 g doses one to four times a day throughout their consumption, the duration of which varied among the subjects from ten months to five years. The researchers claim kidney function for the athletes was not impaired by long-term oral creatine supplementation.

We believe that creatine has the potential to cause damage when taken improperly. One of the major misuses of creatine occurs when the user, like Derek Bell, does not drink enough water for the amount of creatine they consume. The athletes in Poortmans et al. were advised correctly over the duration of the study on how much water to take, thus avoiding dehydration. In contrast, athletes that buy commercial creatine supplements over the counter without proper instruction and knowledge of creatine's potential risks are at a higher risk of suffering adverse effects. These effects may come from either high amounts of creatine in the supplement or potential tainting during manufacture, both of which become more dangerous as dosage increases. Therefore, creatine is more likely to harm a person who consumes and/or naturally produces a large amount of creatine. Without more tests with large sample sizes lasting longer periods of time, there is no way to determine to what extent creatine causes harm, as there are convincing cases both for its potential dangers and for its safety. Right now, it is impossible to know how exactly creatine supplementation affects a wide range of athletes.

## Lack of Quality Control

Not only does pure creatine possibly pose physical danger, but also taking an off-the-shelf creatine supplement could increase the risks. Since the FDA does not regulate nutritional and performance-enhancing supplements, supplement manufacturers are not subject to the same strict scrutiny as pharmaceutical manufacturers. Due to the lack of regulation by the FDA, the presence and quantity of ingredients listed on the label of any supplement, including creatine, are not guaranteed to be accurate. For example, a 2003 study found that seven out of nine ginkgo biloba products did not contain an adequate dose of at least one compound, and products ranged from having no measurable amount of advertised substances to having 150% of the claimed dose[25]. Although little research can be found on the actual contents of creatine-only supplements, because both ginkgo biloba and creatine products are not regulated, it is reasonable to expect that creatine is not exempt from variable manufacturing practices either. Getting less than you paid for is more fiscally than physically dangerous, but if the supplement contains a surplus of a nutrient that is toxic in large doses, then consumers risk poisoning with every supplement they ingest. In the case of creatine, where the dangers of even small doses are being contested, an overdose would be particularly unwise.



**If a creatine supplement contains even trace amounts of banned chemicals, an athlete could test positive for doping and lose his career.**

**Creatine can be consumed naturally via foods such as poultry, meat, and fish.**

Another risk of supplementation for athletes is doping, as there have been many incidences of supplements containing chemicals like steroids prohibited by athletic associations such as the International Olympic Committee. In a large study of American dietary supplements claiming to contain no hormones, 45 of the 240 supplements tested positive for one or more steroids[26]. Tests for many banned substances are extremely sensitive.* If a creatine supplement contains even trace amounts of banned chemicals, an athlete could test positive for doping and lose his career. Various athletic associations have recognized the fact that not all positive tests are the result of intentional doping. However, the current principle of strict liability means that the presence of steroids is the crime, regardless of the athlete's intent or knowledge. Thus, athletes take supplements at their own risk, both to their bodies and their careers.

## Natural Trumps Artificial

The healthiest and safest way for our body to obtain nutrients is through natural foods[26], and acquiring the daily recommended dosage of creatine should be no different. Today, only 25% of people eat enough creatine in their regular diet[19] so if an athlete desires to consume creatine, we believe that he or she should be directed to eat more creatine-rich foods rather than supplement. Because the degradation of creatine occurs at a constant rate of about 2 g/day and the body produces at least 1 gram in the liver, only 1 gram per day is actually needed to maintain creatine levels, though the body can use up to 5 grams daily[19]. Athletes who supplement with creatine tend to get excessively higher amounts of creatine than are needed. For example, a common dosage regimen is to take 20-25 g/day for the first five days of supplementation followed by a maintenance dose of 5-7 g/day, as recommended on the label of Optimum Nutrition's Creatine 2500 Caps[27], a popular creatine supplement. Taking additional creatine beyond the amount needed to increase muscle function and size is an unnecessary risk to one's health if adverse effects do occur.

Creatine can be consumed naturally via foods such as poultry, meat, and fish (Table 1: creatine-rich foods), which contain high enough doses of creatine to prevent creatine level depletion while not so high that overdosing is a problem.

**Table 1. Creatine-Rich Foods**[28, 29]

| Food Type | Tuna | Beef | Pork | Salmon | Chicken Breast | Cod | Herring |
|---|---|---|---|---|---|---|---|
| Creatine Content (g/kg) | 4 | 4.5 | 5 | 4.5 | 3.5 | 3 | 6.5-10 |

*Usually steroid contamination is considered a manufacturing accident because only low doses of banned compounds are present. Nevertheless, since many steroids aid in performance, doubt is cast on how accidental the contamination is. Performance-enhancing products may be deliberately tainted to increase strength. When users notice the positive effects of the supplement, they tend to become more loyal customers and recommenders, not realizing the benefits are due mostly to the hidden steroids.

*We agree with Dr. Mark Myhal, a professor at Ohio State University, who would not advise creatine supplementation because he believes that athletes "really don't need it… as many don't eat properly to begin with."*

These creatine-rich foods tend to be healthy regardless of their creatine content. The amount of creatine absorbed by the muscles remains constant because creatine is unaltered by both digestive acid and enzymatic secretions. We agree with Dr. Mark Myhal, a professor at Ohio State University, who would not advise creatine supplementation because he believes that athletes "really don't need it… as many don't eat properly to begin with."[30] Consuming creatine naturally in doses lower than those found in supplements would greatly reduce accidental doping and the potential health risks of too much creatine, while still allowing athletes to consume as much natural creatine as needed for a healthy lifestyle.

We believe that too much creatine may be detrimental, even though it is essential in moderation. With the expectation of enhancing exercise, this misconception can lead to overdosing in an attempt to capitalize on the benefits of fat-free mass and strength. The dearth of scientifically proven hazards does not necessarily mean safety, as only rigorously controlled randomized trials can disprove all theoretical complications that could arise. The safety of creatine supplementation is drawn further into question by the fact that one can never be sure that the creatine they consume is not tainted with other, more sinister compounds. Moreover, since outcomes in response to creatine have not been shown to mimic any adaptive transformations resulting from exercising, there may be no benefits to supplementing one's diet with creatine. As creatine cannot replace the necessity and value of training for sport preparation, it may be best for modern day athletes to focus less on which supplements will give them the extra edge, but rather direct their energies to working out and naturally building upon what they already have, inch by inch, slowly yet safely.

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## Notes

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