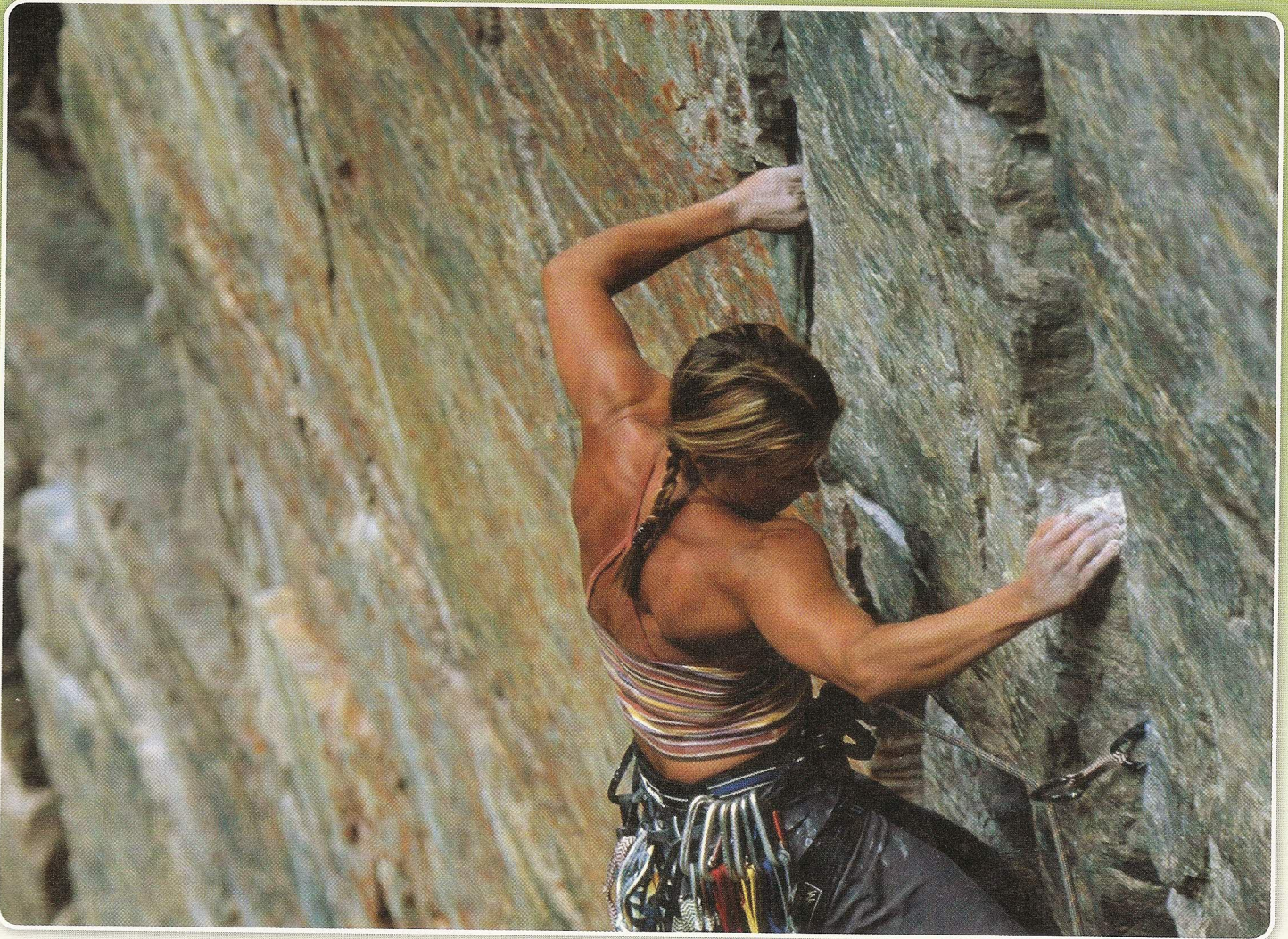


The Muscular System



Climber in Banff National Park, Canada.

CURRENT ISSUE

Drug Abuse Among Athletes

Baseball slugger Barry Bonds was convicted for lying under oath about using performance-enhancing drugs. Sprinter Marion Jones confessed to her drug use and offered a tearful apology, but was stripped of her five Olympic gold medals. High school athletes are routinely being tested for performance-enhancing drugs. What is going on here?

The short answer is that many performance-enhancing drugs do enhance athletic performance. They work in ways that are predictable and understood, based on human physiology. In an environment where just a hundredth of a second can make the difference between an Olympic

gold medal and relative obscurity, the temptation to use these drugs is high.

Anabolic Steroids

Anabolic steroids and related compounds such as dehydroepiandrosterone (DHEA) and androstenedione ("Andro") are the most widely abused drugs in athletics today. Although anabolic steroids are banned by sports federations and school systems, many of them are available over the counter as the result of a 1994 federal law that was written to ensure access to herbal remedies. In general, they are structurally and functionally related to the male sex steroid testosterone. And, like testosterone,



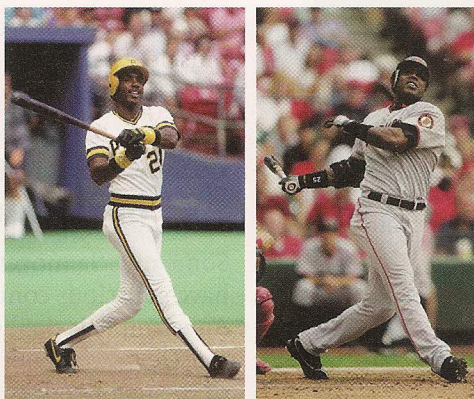
Marion Jones after winning the gold in 2000, and in 2007 after admitting to using performance-enhancing drugs.

they make it easy for the user to increase his/her muscle mass. Muscle strength improves as well, leading to improved athletic performance in sports that require short bursts of energy.

How common is anabolic steroid use? A study funded by the National Institute on Drug Abuse found that 2.5% of 12th-graders, 1.5% of 10th-graders, and 1.1% of 8th-graders had tried them. Information on steroid use by college and professional athletes is unreliable because the athletes are reluctant to talk about it. A few well-known athletes, including Arnold Schwarzenegger, sprinter Ben Johnson, and wrestler Hulk Hogan, have admitted to using them at one time or another.

A recent trend is the increased use of sophisticated “designer drugs” such as THG (tetrahydrogestrinone), designed specifically to avoid detection. THG is known as “the clear” to athletes because allegedly it couldn’t be detected. And for years it wasn’t detected—until an anonymous tipster sent a sample of the drug to a sport federation for testing. THG is so potent that it doesn’t even have to be injected—just a couple of drops under the tongue are enough. In 2007 sprinter Marion Jones finally admitted that she started using THG in 1999 as she prepared for the 2000 Olympic Games. She was stripped of her five medals from the 2000 Olympics and banned from participation in the 2008 Olympics in Beijing.

Aside from the obvious issue of fairness in athletic competition, anabolic steroids are banned by sports federations because of their side effects and possible health risks. Androgens have masculinizing effects in both sexes. Men may experience gynecomastia (enlargement of the breasts), shrinkage of the testicles, reduced sperm production, and impotence. In women, breast size and body fat decrease and the voice deepens. Women may lose scalp hair but gain body hair. Some of these changes are not reversible. Anabolic steroid abuse is also associated with irritability, hostility, and



A young Barry Bonds playing for the Pirates, and years later, a bulkier Barry as the SF Giants’ slugger.

aggressive behavior (“roid rage”). Prolonged anabolic steroid abuse is associated with an increased risk of heart attack, stroke, and severe liver disease, including liver cancer. Although the number of cases of these diseases is fairly low (so far), the effects of steroid use/abuse may be underestimated because these diseases tend to come later in life. We just don’t know what will happen to steroid abusers 30 years later.

Blood Enhancers

Marathoners and cyclists aren’t interested in muscle mass; they’re interested in maintaining a high level of sustained performance over long periods of time. For that, they need increased aerobic capacity. Their (banned) drug of choice is erythropoietin (EPO), a hormone produced by the kidneys that increases the production of red blood cells. EPO is available by prescription only for patients with *anemia* (too few red blood cells in the blood). But cyclists and marathon runners use it to improve their performance. It’s all a matter of normal human physiology; EPO produces more red blood cells, which leads to a higher oxygen-carrying capacity, which in turn leads to a higher level of sustainable muscle activity and faster times.

But a health risk is associated with EPO abuse. Excessive production of red blood cells can raise the hematocrit (the percentage of the blood that is red cells) to dangerous levels. The blood becomes sludge-like, increasing the risk of high blood pressure, blood clots, and heart attacks. Statistically, one of the most common causes of death among professional cyclists is heart attack, although no deaths have ever officially been listed as having been caused by EPO.

It’s hard to test for EPO abuse because EPO disappears from the blood within days, leaving behind an increased hematocrit and an improved endurance that lasts for a month or more. The cycling organizations are only able to curb EPO abuse by setting an upper limit for hematocrit of 50%; above that, EPO abuse is just assumed and the athlete is banned from competition. It is widely suspected that cyclists who choose to abuse EPO measure their hematocrit shortly before a race and then remove blood cells to just meet the 50% rule!

Next Up: Gene Doping

Within decades, it will probably be possible to use genetic engineering techniques to modify an athlete’s genes for improved athletic performance. It’s called *gene doping*. What if you could tinker with the genes that lead to the production of natural erythropoietin or testosterone, so that an athlete just naturally produces more of these hormones? What if you could alter muscle biochemistry so that muscles used energy more efficiently or more rapidly? What if you could insert genes that caused muscle cells to store up more ATP? These ideas are not so far-fetched. Nearly all experts on the subject are convinced that if gene doping hasn’t been tried already, it soon will be. Gene doping will be extremely hard to detect or to prevent.

Have we lost our perspective for the role that sports should play in our lives?

QUESTIONS TO CONSIDER

- 1 Do you think we should continue to try to prevent the use of drugs and genetic engineering in sports? Why or why not?
- 2 A friend who uses anabolic steroids says that there is no convincing scientific evidence that anabolic steroid use will lead to health problems such as heart disease or cancer later in life. Is he right? What would you say to him?

THE FACTS...

- Performance-enhancing drugs such as anabolic steroids and erythropoietin (EPO) are used by some athletes because they improve certain types of athletic performance.
- Abuse of performance-enhancing drugs can lead to unwanted side effects, an increased risk of certain chronic diseases, and perhaps even premature death.
- Although most sports federations have banned the use of performance-enhancing drugs, enforcement has proven difficult.
- Soon it may be possible to use genetic engineering techniques to enhance athletic performance.