

Research Report

SERIES

ANABOLIC STEROID ABUSE

Persistent reports of anabolic steroid abuse by professional athletes, many of whom are regarded as role models by young people, highlight the fact that we are now facing a very damaging message in our society—that bigger is better, and being the best is more important than how you get there.

Abuse of anabolic steroids differs from the abuse of other illicit substances because the initial abuse of anabolic steroids is not driven by the immediate euphoria that accompanies most drugs of abuse, such as cocaine, heroin, and marijuana, but by the desire of abusers to change their appearance and performance, characteristics of great importance to adolescents. The effects of steroids can boost confidence and strength, leading abusers to overlook the potential serious and long-term damage that these substances can cause.

While anabolic steroids can enhance certain types of performance or appearance, they are dangerous drugs, and when used inappropriately they can cause a host of severe, long-lasting, and in some cases, irreversible negative health consequences. Anabolic steroids can lead to early heart attacks, strokes, liver tumors, kidney failure, and serious psychiatric problems. In addition, because steroids are often injected, users who share needles or use non-sterile techniques when they inject steroids are at risk for contracting dangerous infections, such as HIV/AIDS and hepatitis B and C.

I hope that students, parents, teachers, coaches, and others will take advantage of the information about anabolic steroids found on the NIDA Web site (www.steroid-abuse.gov) and join us in our prevention and education efforts. Participating in sports offers many benefits, but young people and adults should not take unnecessary health risks in an effort to win.

Nora D. Volkow, M.D.
 Director
 National Institute on Drug Abuse

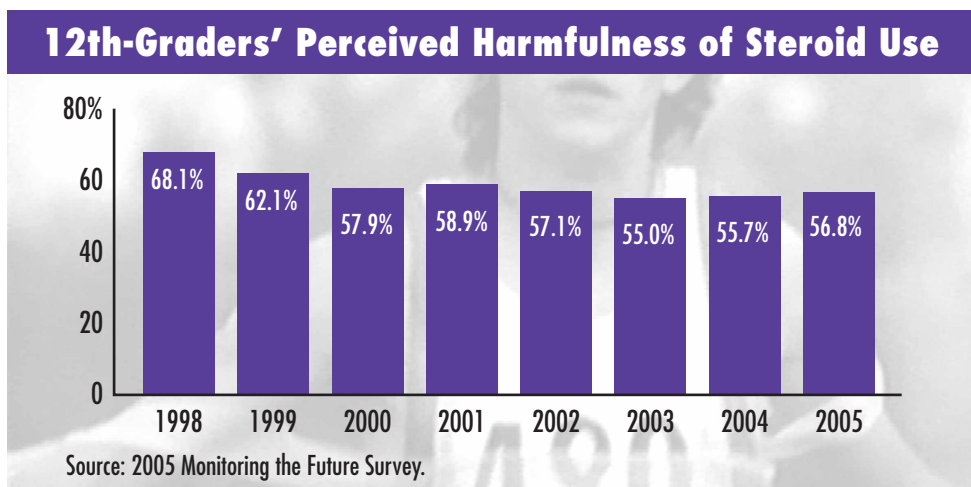
What are anabolic steroids?

“Anabolic steroids” is the familiar name for synthetic substances related to the male sex hormones (e.g., testosterone). They promote the growth of skeletal muscle (anabolic effects) and the development of male sexual characteristics (androgenic effects) in both males and females. The term “anabolic steroids” will be used throughout this report because of its familiarity, although the proper term for these compounds is “anabolic-androgenic steroids.”

Anabolic steroids were developed in the late 1930s primarily to treat hypogonadism, a condition in which the testes do not produce sufficient testosterone for normal growth, development, and sexual functioning. The primary medical uses of these compounds are to treat delayed puberty, some types of impotence, and wasting of the body caused by HIV infection or other diseases.

During the 1930s, scientists discovered that anabolic steroids could facilitate the growth of skeletal muscle in laboratory animals, which led to abuse of

from the director



the compounds first by body-builders and weightlifters and then by athletes in other sports. Steroid abuse has become so widespread in athletics that it can affect the outcome of sports contests.

Illicit steroids are often sold at gyms, competitions, and through mail order operations after being smuggled into this country. Most illegal steroids in the United States are smuggled from countries that do not require a prescription for the purchase of steroids. Steroids are also illegally diverted from U.S. pharmacies or synthesized in clandestine laboratories.

What are steroidal supplements?

In the United States, supplements such as tetrahydrogestrinone (THG) and androstenedione (street name “Andro”) previously could be purchased legally without a prescription through many commercial sources, including health food stores. Steroidal supplements can be converted into testosterone or a similar compound in the body. Less is known about the side effects of steroidal supplements, but if large quantities of these compounds substantially increase testosterone levels in the body, then they also are likely to produce the same side effects as anabolic steroids themselves. The purchase of these supplements, with the notable exception of dehydroepiandrosterone (DHEA), became illegal after the passage in 2004 of amendments to the Controlled Substances Act.

What is the scope of steroid use in the United States?

The 2005 Monitoring the Future study, a NIDA-funded survey of drug use among adolescents in middle and high schools across the United States, reported that past year use of steroids decreased significantly among 8th- and 10th-graders since peak use in 2000. Among 12th-graders, there was a different trend—from 2000 to 2004, past year steroid use increased, but in 2005 there was a significant decrease, from 2.5 percent to 1.5 percent.

Steroid abuse affects individuals of various ages. However, it is difficult to estimate the true prevalence of steroid abuse in the United States because many data sources that measure drug abuse do not include steroids. Scientific evidence indicates that anabolic steroid abuse among athletes may range between one and six percent.

Why do people abuse anabolic steroids?

One of the main reasons people give for abusing steroids is to improve their athletic performance. Among athletes, steroid abuse has been estimated to be less than 6 percent according to surveys, but anecdotal information suggests more widespread abuse. Although testing procedures are now in place to deter steroid abuse among professional and Olympic athletes, new designer drugs constantly become available that can escape detection and put athletes willing to cheat one step ahead of testing efforts. This dynamic, however, may be about to shift if the saving of urine and blood samples for retesting at a future date becomes the standard. The high probability of eventual detection of the newer designer steroids, once the technology becomes

Commonly Abused Steroids

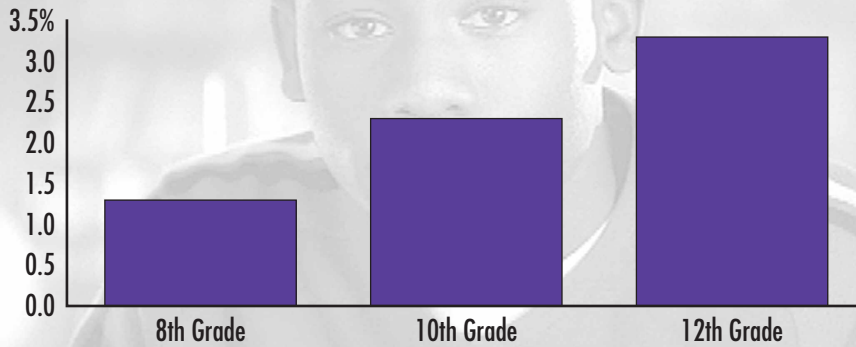
Oral Steroids

- Anadrol (oxymetholone)
- Oxandrin (oxandrolone)
- Dianabol (methandrostenolone)
- Winstrol (stanozolol)

Injectable Steroids

- Deca-Durabolin (nandrolone decanoate)
- Durabolin (nandrolone phenpropionate)
- Depo-Testosterone (testosterone cypionate)
- Equipoise (boldenone undecylenate)
- Tetrahydrogestrinone (THG)

Annual Prevalence of Steroid Use Among Males Grades 8, 10, 12



Source: 2005 Monitoring the Future Survey.

available, plus the fear of retroactive sanctions, should give athletes pause.

Another reason people give for taking steroids is to increase their muscle size or to reduce their body fat. This group includes people suffering from the behavioral syndrome called muscle dysmorphia, which causes them to have a distorted image of their bodies. Men with muscle dysmorphia think that they look small and weak, even if they are large and muscular. Similarly, women with this condition think that they look fat and flabby, even though they are actually lean and muscular.

Some people who abuse steroids to boost muscle size have experienced physical or sexual abuse. In one series of interviews with male weightlifters, 25 percent who abused steroids reported memories of childhood physical or sexual abuse. Similarly, female weightlifters who had been raped were found to be twice as likely to report use of anabolic steroids or another purported muscle-building drug, compared with those who had not been raped. Moreover, almost all of those

who had been raped reported that they markedly increased their bodybuilding activities after the attack. They believed that being bigger and stronger would discourage further attacks because men would find them either intimidating or unattractive.

Finally, some adolescents abuse steroids as part of a pattern of high-risk behaviors. These adolescents also take risks such as drinking and driving, carrying a gun, driving a motorcycle without a helmet, and abusing other illicit drugs. Conditions such as muscle dysmorphia, a history of physical or sexual abuse, or a history of engaging in high-risk behaviors have all been associated with an increased risk of initiating or continuing steroid abuse.

How are anabolic steroids abused?

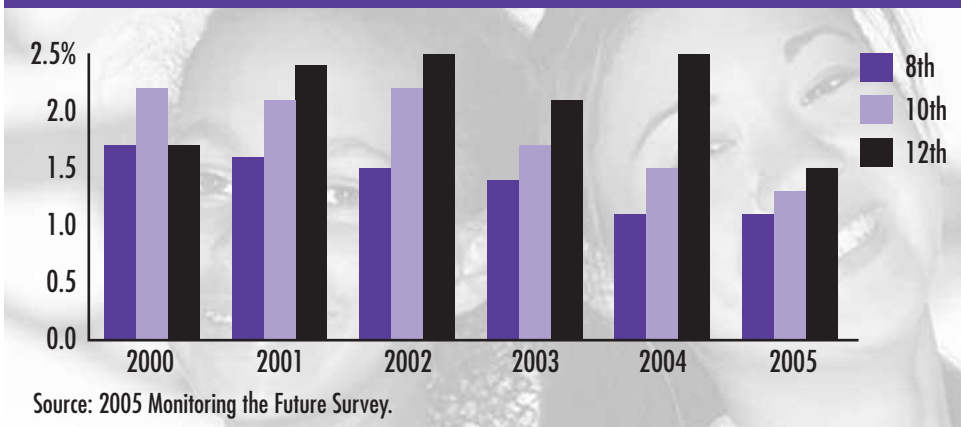
Some anabolic steroids are taken orally, others are injected intramuscularly, and still others are provided in gels or creams that are applied to the skin. Doses taken by abusers can be 10 to 100 times higher than the doses used for medical conditions.

Cycling, stacking, and pyramiding

Steroids are often abused in patterns called “cycling,” which involve taking multiple doses of steroids over a specific period of time, stopping for a period, and starting again. Users also frequently combine several different types of steroids in a process known as “stacking.” Steroid abusers typically “stack” the drugs, meaning that they take two or more different anabolic steroids, mixing oral and/or injectable types, and sometimes even including compounds that are designed for veterinary use. Abusers think that the different steroids interact to produce an effect on muscle size that is greater than the effects of each drug individually, a theory that has not been tested scientifically.

Another mode of steroid abuse is referred to as “pyramiding.” This is a process in which users slowly escalate steroid abuse (increasing the number of steroids or the dose and frequency of one or more steroids used at one time), reaching a peak amount at mid-cycle and gradually tapering the dose toward the end of the cycle. Often, steroid abusers pyramid their doses in cycles of 6 to 12 weeks. At the beginning of a cycle, the person starts with low doses of the drugs being stacked and then slowly increases the doses. In the second half of the cycle, the doses are slowly decreased to zero. This is sometimes followed by a second cycle in which the person continues to train but without drugs. Abusers believe that pyramiding allows the body time to adjust to the high doses,

Annual Prevalence of Use of Steroids 8th-Graders, 10th-Graders, and 12th-Graders



and the drug-free cycle allows the body’s hormonal system time to recuperate. As with stacking, the perceived benefits of pyramiding and cycling have not been substantiated scientifically.

What are the health consequences of steroid abuse?

Anabolic steroid abuse has been associated with a wide range of adverse side effects ranging from some that are physically unattractive, such as acne and breast development in men, to others that are life threatening, such as heart attacks and liver cancer. Most are reversible if the abuser stops taking the drugs, but some are permanent, such as voice deepening in females.

Most data on the long-term effects of anabolic steroids in humans come from case reports rather than formal epidemiological studies. From the case reports, the incidence of life-threatening effects appears to be low, but serious adverse effects

may be underrecognized or underreported, especially since they may occur many years later. Data from animal studies seem to support this possibility. One study found that exposing male mice for one-fifth of their life-span to steroid doses comparable to those taken by human athletes caused a high frequency of early deaths.

Hormonal system

Steroid abuse disrupts the normal production of hormones in the body, causing both reversible and irreversible changes. Changes that can be reversed include reduced sperm production and shrinking of the testicles (testicular atrophy). Irreversible changes include male-pattern baldness and breast development (gynecomastia) in men. In one study of male bodybuilders, more than half had testicular atrophy and/or gynecomastia.

In the female body, anabolic steroids cause masculinization. Breast size and body fat decrease, the skin becomes coarse, the clitoris enlarges, and the voice deepens. Women may experience excessive growth of body hair

but lose scalp hair. With continued administration of steroids, some of these effects become irreversible.

Musculoskeletal system

Rising levels of testosterone and other sex hormones normally trigger the growth spurt that occurs during puberty and adolescence and provide the signals to stop growth as well. When a child or adolescent takes anabolic steroids, the resulting artificially high sex hormone levels can prematurely signal the bones to stop growing.

Cardiovascular system

Steroid abuse has been associated with cardiovascular diseases (CVD), including heart attacks and strokes, even in athletes younger than 30. Steroids contribute to the development of CVD, partly by changing the levels of lipoproteins that carry cholesterol in the blood. Steroids, particularly oral steroids, increase the level of low-density lipoprotein (LDL) and decrease the level of high-density lipoprotein (HDL). High LDL and low HDL levels increase the risk of atherosclerosis, a condition in which fatty substances are deposited inside arteries and disrupt blood flow. If blood is prevented from reaching the heart, the result can be a heart attack. If blood is prevented from reaching the brain, the result can be a stroke.

Steroids also increase the risk that blood clots will form in blood vessels, potentially disrupting blood flow and damaging the heart muscle so that it does not pump blood effectively.

Liver

Steroid abuse has been associated with liver tumors and a rare condition called peliosis hepatis, in which blood-filled cysts form in the liver. Both the tumors and the cysts can rupture, causing internal bleeding.

Skin

Steroid abuse can cause acne, cysts, and oily hair and skin.

Infections

Many abusers who inject anabolic steroids may use nonsterile injection techniques or share contaminated needles with other abusers. In addition, some steroid preparations are manufactured illegally under nonsterile conditions. These factors put abusers at risk for acquiring life-threatening viral infections, such as HIV and hepatitis B and C. Abusers also can develop endocarditis, a bacterial infection that causes a potentially fatal inflammation of the inner lining of the heart. Bacterial infections also can cause pain and abscess formation at injection sites.

What effects do anabolic steroids have on behavior?

Case reports and small studies indicate that anabolic steroids, when used in high doses, increase irritability and aggression. Some steroid abusers report that they have committed aggressive acts, such as physical fighting or armed robbery, theft, vandalism, or burglary. Abusers who have committed aggressive

acts or property crimes generally report that they engage in these behaviors more often when they take steroids than when they are drug free. A recent study suggests that the mood and behavioral effects seen during anabolic-androgenic steroid abuse may result from secondary hormonal changes.

Scientists have attempted to test the association between anabolic steroids and aggression by administering high steroid doses or placebo for days or weeks to human volunteers and then asking the people to report on their behavioral symptoms. To date, four such studies have been conducted. In three, high steroid doses did produce greater feelings of irritability and aggression than did placebo, although the effects appear to be highly variable across individuals. In one study, the drugs did not have that effect. One possible explanation, according to the researchers, is that some but not all anabolic steroids increase irritability and aggression. Recent animal studies show an increase in aggression after steroid administration.

In a few controlled studies, aggression or adverse, overt behaviors resulting from the administration of anabolic steroid use have been reported by a minority of volunteers.

In summary, the extent to which steroid abuse contributes to violence and behavioral disorders is unknown. As with the health complications of steroid abuse, the prevalence of extreme cases of violence and behavioral

Possible Health Consequences of Anabolic Steroid Abuse

Hormonal system

- men
 - infertility
 - breast development
 - shrinking of the testicles
 - male-pattern baldness
- women
 - enlargement of the clitoris
 - excessive growth of body hair
 - male-pattern baldness

Musculoskeletal system

- short stature (if taken by adolescents)
- tendon rupture

Cardiovascular system

- increases in LDL; decreases in HDL
- high blood pressure
- heart attacks
- enlargement of the heart's left ventricle

Liver

- cancer
- peliosis hepatis
- tumors

Skin

- severe acne and cysts
- oily scalp
- jaundice
- fluid retention

Infection

- HIV/AIDS
- hepatitis

Psychiatric effects

- rage, aggression
- mania
- delusions

disorders seems to be low, but it may be underreported or underrecognized.

Research also indicates that some users might turn to other drugs to alleviate some of the negative effects of anabolic steroids. For example, a study of 227 men admitted in 1999 to a private treatment center for addiction to heroin or other opioids found that 9.3 percent had abused anabolic steroids before trying any other illicit drug. Of these 9.3 percent, 86 percent first used opioids to counteract insomnia and irritability resulting from anabolic steroids.

Are anabolic steroids addictive?

An undetermined percentage of steroid abusers may become addicted to the drugs, as evidenced by their continued abuse despite physical problems and negative effects on social relations. Also, steroid abusers typically spend large amounts of time and money obtaining the drugs, which is another indication that they may be addicted. Individuals who abuse steroids can experience withdrawal symptoms when they stop taking steroids, such as mood swings, fatigue, restlessness, loss of appetite, insomnia, reduced sex drive, and steroid cravings. The most dangerous of the withdrawal symptoms is depression, because it sometimes leads to suicide attempts. If left untreated, some depressive symptoms associated with

anabolic steroid withdrawal have been known to persist for a year or more after the abuser stops taking the drugs.

What can be done to prevent steroid abuse?

Most prevention efforts in the United States today focus on athletes involved with the Olympics and professional sports; few school districts test for abuse of illicit drugs. It has been estimated that close to 9 percent of secondary schools conduct some sort of drug testing program, presumably focused on athletes, and that less than 4 percent of the Nation's high schools test their athletes for steroids. Studies are currently under way to determine whether such testing reduces drug abuse.

Research on steroid educational programs has shown that simply teaching students about steroids' adverse effects does not convince adolescents that they can be adversely affected. Nor does such instruction discourage young people from taking steroids in the future. Presenting both the risks and benefits of anabolic steroid use is more effective in convincing adolescents about steroids' negative effects, apparently because the students find a balanced approach more credible, according to the researchers.

NIDA-funded prevention research helps reduce steroid abuse.

A more sophisticated approach has shown promise for preventing steroid abuse among players on high school sports teams. The Adolescents Training and Learning to Avoid Steroids (ATLAS) program is showing high school football players that they do not need steroids to build powerful muscles and improve athletic performance. By educating student athletes about the harmful effects of anabolic steroids and providing nutrition and weight-training alternatives to steroid use, the ATLAS program has increased football players' healthy behaviors and reduced their intentions to abuse steroids. In the program, coaches and team leaders teach the harmful effects of anabolic steroids and other illicit drugs on immediate sports performance, and discuss how to refuse offers of drugs.

Studies show that 1 year after completion of the program, compared with a control group, ATLAS-trained students in 15 high schools had:

- Half the incidence of new abuse of anabolic steroids and less intention to abuse them in the future;
- Less abuse of alcohol, marijuana, amphetamines, and narcotics;
- Less abuse of "athletic enhancing" supplements;

- Less likelihood of engaging in hazardous substance abuse behaviors such as drinking and driving;
- Increased protection against steroid and other substance abuse. Namely, less interest in trying steroids, less desire to abuse them, better knowledge of alternatives to steroid abuse, improved body image, and increased knowledge of diet supplements.

The Athletes Targeting Healthy Exercise and Nutrition Alternatives (ATHENA) program was patterned after the ATLAS program, but designed for adolescent girls on sports teams. Early testing of girls enrolled in the ATHENA program showed significant decreases in risky behaviors. While preseason risk behaviors were similar among controls and ATHENA participants, the control athletes were three times more likely to begin using diet pills and almost twice as likely to begin abuse of other body-shaping substances, including amphetamines, anabolic steroids, and muscle-building supplements during the sports season. The use of diet pills increased among control subjects, while use fell to approximately half of the preseason levels among ATHENA participants. In addition, ATHENA team members were less likely to be sexually active, more likely to wear seatbelts, less likely to ride in a car with a driver who had been drinking, and they experienced fewer injuries during the sports season.

Both Congress and the Substance Abuse and Mental

Health Services Administration have endorsed ATLAS and ATHENA as model prevention programs. These Oregon Health & Science University programs have been awarded the 2006 annual *Sports Illustrated* magazine's first-ever "Champion Award."

What treatments are effective for anabolic steroid abuse?

Few studies of treatments for anabolic steroid abuse have been conducted. Current knowledge is based largely on the experiences of a small number of physicians who have worked with patients undergoing steroid withdrawal. The physicians have found that supportive therapy is sufficient in some cases. Patients are educated about what they may experience during withdrawal and are evaluated for suicidal thoughts. If symptoms are severe or prolonged, medications or hospitalization may be needed.

Some medications that have been used for treating steroid withdrawal restore the hormonal system after its disruption by steroid abuse. Other medications target specific withdrawal symptoms—for example, antidepressants to treat depression and analgesics for headaches and muscle and joint pains.

Some patients require assistance beyond pharmacological treatment of withdrawal symptoms and are treated with behavioral therapies.

Where can I get further scientific information about steroid abuse?

To learn more about anabolic steroids and other drugs of abuse, contact the National Clearinghouse for Alcohol and Drug Information (NCADI) at 800-729-6686. Information specialists are available to help you locate information and resources.

Fact sheets, including *InfoFacts*, on the health effects of anabolic steroids, other drugs of abuse, and other drug topics are available on the NIDA Web site (www.drugabuse.gov), and can be ordered free of charge in English and Spanish from NCADI at www.health.org.

Access information on the Internet

- What's new on the NIDA Web site
- Information on drugs of abuse
- Publications and communications (including *NIDA NOTES*)
- Calendar of events
- Links to NIDA organizational units
- Funding information (including program announcements and deadlines)
- International activities
- Links to related Web sites (access to Web sites of many other organizations in the field)

NIDA Web Sites

www.drugabuse.gov
www.steroidabuse.gov
www.clubdrugs.gov
www.hiv.drugabuse.gov
www.inhalant.drugabuse.gov

NCADI

Web Site: www.health.org
 Phone No.: 800-729-6686

Glossary

Addiction: A chronic, relapsing disease, characterized by compulsive drug seeking and abuse and by long-lasting chemical changes in the brain.

Anabolic effects: Drug-induced growth or thickening of the body's nonreproductive tract tissues—including skeletal muscle, bones, the larynx, and vocal cords—and a decrease in body fat.

Analgesics: A group of medications that reduce pain.

Androgenic effects: A drug's effects upon the growth of the male reproductive tract and the development of male secondary sexual characteristics.

Antidepressants: A group of medications used in treating depressive disorders.

Cardiovascular system: The heart and blood vessels.

Hormone: A chemical substance formed in glands in the body and carried by the blood to organs and tissues, where it influences function, structure, and behavior.

Musculoskeletal system: The muscles, bones, tendons, and ligaments.

Placebo: An inactive substance (pill, liquid, etc.), which is administered to a comparison group, as if it were therapy, but which has no therapeutic value other than to serve as a negative control.

Sex hormones: Hormones that are found in higher quantities in one sex than in the other. Male sex hormones are the androgens, which include testosterone; and the female sex hormones are the estrogens and progesterone.

Withdrawal: Symptoms that occur after chronic use of an addictive drug is reduced or stopped.



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