

# AMERICAN ACADEMY OF PEDIATRICS

Committee on Sports Medicine and Fitness

## Adolescents and Anabolic Steroids: A Subject Review

**ABSTRACT.** This revision of a previous statement by the American Academy of Pediatrics provides current information on anabolic steroid use by young athletes. It provides the information needed to enable pediatricians to discuss the benefits and risks of anabolic steroids in a well-informed, nonjudgmental fashion.

### DEFINITION OF THE PROBLEM

The use of a variety of substances has long accompanied efforts to enhance athletic performance.<sup>1</sup> Such use is not limited to professional and Olympic athletes. Studies focusing on anabolic steroids have shown a continuing and significant increase of use among adolescent athletes and nonathletes alike (Table 1).<sup>2-5</sup> In response to the alarming high rate of use of anabolic steroids and the attendant medical risks, policy statements were issued by the American Academy of Pediatrics in 1989 and the American College of Sports Medicine in 1977 and 1984.<sup>6-8</sup> These statements condemn the use of anabolic steroids but acknowledge that they may enhance strength. It has become evident that prohibitions against anabolic steroid use and claims that steroids lack efficacy or produce harm have been insufficient to curtail their use.<sup>9-11</sup>

The American Academy of Pediatrics continues to condemn the use of anabolic steroids for body building or enhancement of sports performance. However, many users, their parents, and their coaches feel that anabolic steroids are useful and even necessary for optimal performance. The Academy's strong opposition to anabolic steroid use may be offset by societies' high rewards for success in sports and a "win at all costs" attitude. Adolescents must interpret mixed messages about the appropriateness of anabolic steroid use as well as ambiguous messages about the benefits and risks of using anabolic steroids. There is a clear need for input that is objective, rational, nonbiased, and readily available to the adolescent. If pediatricians and other pediatric health care advocates are to serve as a much needed "voice of reason," they must be familiar with current information on the risks and benefits of anabolic steroids, use patterns, and the incentives and disincentives for use.

This subject review has been approved by the Council on Child and Adolescent Health.

The recommendations in this statement do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

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### BACKGROUND

Nonmedical use of anabolic steroids was initially reported in weight lifters and other "strength" athletes in the 1950s.<sup>13</sup> The purported benefit to these athletes was a gain in strength and muscle size beyond that which could be achieved with rigorous training and diet alone. The strength gains and performance-enhancing benefits from anabolic steroids were challenged and often discounted by early medical studies. In 1984, Haupt and Rovere<sup>14</sup> thoroughly reviewed published studies on the efficacy of anabolic steroids. Gains in muscle strength and size do occur, and have been most consistent among subjects using anabolic steroids in conjunction with an adequate dietary nitrogen supply and an adequate strength-training program. The benefit of increased muscle size and strength on sports performance appears to vary with the physical demands of the sport. The benefit is potentially more significant in strength-dependent sports such as weight lifting, shot put throwing, and football (linemen). Increased muscle size and bulk have fewer potential benefits for participation in sports that require speed, agility, flexibility, and/or endurance.

### Administration and Mechanisms of Action

Anabolic steroids may be administered orally or by intramuscular injection.<sup>15</sup> Some of the common orally administered anabolic steroids include oxymetholone (Anadrol), oxandrolone (Anavar), methandrostenolone (Dianabol), and stanozolol (Winstrol). Some of the injectable steroids include nandrolone decanoate (Deca-Durabolin), nandrolone phenpropionate (Durabolin), testosterone cypionate (Depo-Testosterone), and boldenone undecylenate (Equipoise).

Individuals using anabolic steroids typically use a combination of oral and injectable drugs during 6- to 12-week cycles. The injectable forms are favored by users because they are less hepatotoxic than oral preparations. However, the oral preparations tend to be cleared more rapidly from the system and may be preferred when drug testing is anticipated.

The simultaneous use of multiple steroid preparations is called "stacking," and the pattern of increasing a dose through a cycle is referred to as "pyramiding." Pyramiding may lead to doses of 10 to 40 times greater than those used for medical indications. Stacking and pyramiding are intended to maximize steroid receptor binding and minimize toxic side effects. The fact that these benefits have not been substantiated scientifically has not appreciably influenced dosing patterns.

**TABLE 1.** Prevalence of Androgenic Anabolic Steroid Abuse\*

Population	Average Age of Users	Number of Respondents	Prevalence (%)	Ref.
Bodybuilders				31
Men	27 years	108	54.6	
Women	24 years	68	10.3	
College students (age not reported)				32
Athletes	1970		15	
	1976		20	
	1980		20	
	1984		20	
Nonathletes	1984		1	
Male bodybuilders	25 years	138	38.4	33
12th-grade male students	17.2 years	3403	6.6	3
11th-grade male (age not reported) students		853	11.1	4
High school students				2
Male	16 years	462	5.0	
Female		439	1.4	
High school students				5
2113 total (sic)				
534 grade 9				
496 grade 10				
518 grade 11				
542 grade 12				
Male		1028	6.5	
Female		1085	2.5	

\* Adapted from Smith and Perry.<sup>15</sup>

Anabolic steroids are believed to exert their effects by binding to androgen receptors at the cellular level, stimulating production of RNA, and ultimately increasing protein synthesis. The various clinical effects are determined by the type and concentrations of androgen receptors and enzymes controlling steroid metabolism in a given organ. The structure of androgen receptors appears to be identical in muscle and other organs.

Anabolic steroids have been shown to have an anticatabolic effect by improving utilization of protein and by inhibiting the catabolic effect of glucocorticoids.<sup>14,16</sup> In addition, anabolic steroids may lead to gains in strength by increasing the athlete's aggressiveness, producing euphoria, or decreasing the athlete's sense of fatigue during training. These psychological effects may allow a higher intensity and longer duration of training. A summary of the desired effects of anabolic steroids in sports competitors appears in Table 2.

#### Side Effects

Many excellent reviews on the adverse effects of anabolic steroids are available (Table 3).<sup>14-21</sup> Because clinical trials are not feasible, much of the information on adverse reactions is anecdotal, or is assumed

**TABLE 2.** Desired Effects of Anabolic Steroids as Perceived by Sports Competitors\*

Increased muscle mass
Increased strength
Decreased recovery time
Increased aggression
Promote healing of injuries
Maintain same "advantage" as one's opponent
Obtaining a winning edge

\* Adapted from Hough.<sup>19</sup>

from known problems associated with therapeutic use of these agents.

Elevations in levels of liver enzymes (aspartate aminotransferase, alanine aminotransferase, and lactate dehydrogenase) are common, whereas the more severe hepatic complications are rare. In men, steroid use depresses levels of luteinizing hormone and follicle-stimulating hormones, which leads to decreased endogenous testosterone production, decreased spermatogenesis, and testicular atrophy. Gynecomastia may result from the peripheral conversion of androgens to estradiol and estrone. The masculinizing effects of anabolic steroids in women include hirsutism, acne, deepening of the voice, clitoral hypertrophy, and male-pattern baldness. These androgenic effects may be irreversible.

Anabolic steroids may adversely affect the serum lipid profile, but their long-term effects on the development of coronary artery disease have not been determined. Thrombotic phenomena associated with anabolic steroid use include strokes, myocardial infarctions, and limb loss.<sup>22,23</sup>

Some individuals may experience mental status and behavioral changes with anabolic steroid use, including irritability, aggressiveness, euphoria, depression, mood swings, altered libido, and even psychosis.<sup>24</sup> Anabolic steroid withdrawal and dependency disorders have also been reported.<sup>25</sup> Acute anabolic steroid withdrawal may produce symptoms of central nonadrenergic hyperactivity including anxiety, irritability, insomnia, hot flashes, sweats, chills, anorexia, myalgia, nausea, vomiting, piloerection, tachycardia, and hypertension. Depression and anabolic steroid craving may also occur with withdrawal.<sup>25</sup>

Of particular concern is premature physeal closure

**TABLE 3.** Possible Adverse Effects of Anabolic Steroids\*

Liver
Hepatocellular damage
Cholestasis
Peliosis hepatis
Hepatoadenoma
Hepatocarcinoma
Reproductive
Males
Testicular atrophy
Oligo- or azoospermia
Impotence
Prostatic hypertrophy
Prostatic carcinoma
Gynecomastia
Females
Amenorrhea
Clitoromegaly
Uterine atrophy
Breast atrophy
Teratogenicity
Musculoskeletal
Early closure of physes in children (shorter adult height)
Increased rate of muscle strains/ruptures
Endocrine (other than reproductive)
Decreased glucose tolerance
Integument
Acne
Striae
Hirsutism
Male pattern baldness
Edema
Larynx
Deepening of the voice
Cardiovascular
Increased cholesterol
Decreased HDL cholesterol
Increased blood pressure
Thrombosis
Urinary
Wilm's tumor
Psychologic
Mood swings
Aggressiveness
Depression
Psychosis
Addiction
Immunologic (infectious)
Decreased IgA levels
Hepatitis B or C; HIV infection (if needles are shared)
Withdrawal and Dependency Disorders

\* Adapted from Landry and Primos.<sup>20</sup>

in any child/adolescent, which results in a decrease in adult height.

### Patterns of Anabolic Steroid Use

Surveys on the prevalence of anabolic steroid use in various populations continue to be published (Table 1).<sup>15</sup> The prevalence of self-reported use of anabolic steroids in adolescents has ranged from 5% to 11% of males<sup>2-4</sup> and up to 2.5% of females.<sup>5</sup> Athletes in nonschool sports as well as nonathletes have been shown to represent a significant portion of the user population.<sup>12</sup>

Combined drug use patterns are seen when anabolic steroid users take additional nonsteroidal substances such as human growth hormone<sup>26</sup> or clenbuterol<sup>27</sup> for performance enhancement or anabolic effect. Durant et al<sup>28</sup> showed that anabolic steroid use in adolescents was significantly associated with previous use of cocaine, injectable drugs, alcohol, mar-

ijuana, shared needles, and smokeless tobacco. An 18-year-old male who used injectable anabolic steroids has been reported to have acquired immunodeficiency virus infection from sharing needles and syringes.<sup>29</sup>

### SUMMARY OF EMERGING DATA

New reports of previously unrecognized patterns of use, side effects, or complications of anabolic steroids continue to emerge. Perhaps the most compelling aspect of the "new literature" is what is *not* reported. To our knowledge, no study has identified an adolescent population without the temptation and risks of anabolic steroid use. Furthermore, no study has been published showing a *decrease* in the prevalence of anabolic steroid use over time (though a recent American Medical Association report suggests that this may be occurring) or in response to educational programs.

Educational programs directed toward potential users of anabolic steroids have been advocated with the hope that greater knowledge of medical risk would discourage use.<sup>6</sup> Unfortunately, greater knowledge does not clearly change attitudes or behaviors.<sup>10</sup> Educational programs that are biased toward presenting negative side effects (scare tactics) tend to widen the credibility gap between anabolic steroid users and health professionals.<sup>9</sup> Even if the potential benefits of anabolic steroids are acknowledged, many health professionals are concerned that admitting to such benefits may inadvertently condone their use.

Drug-testing programs at the collegiate and Olympic level do not appear to deter anabolic steroid use in aspiring adolescent athletes. In fact, public reporting of drug use violations may paradoxically serve to promote the perceived performance-enhancing benefits of anabolic steroids.<sup>9</sup> Drug testing for these agents at the high school or youth sport levels is impractical and unlikely to occur. Furthermore, sanctions against anabolic steroid users are not enforceable without direct proof of drug use.

### CONCLUSIONS

Pediatric practitioners cannot depend on community education programs or drug testing to curb the use of anabolic steroids in adolescents. Without evidence to show a significant and consistent decline in use or increasing safety of anabolic steroids, a passive approach to the problem is difficult to justify. The medical community is united in its belief that the use of anabolic steroids and other performance-enhancing substances is unacceptable, therefore, health care providers are obligated to provide sound guidance for those who seek advice.

Pediatricians have an opportunity to fulfill a positive role in the recognition and management of anabolic steroid abuse in adolescents. Recognition begins with an appreciation of the at-risk population. Potential anabolic steroid users have been and will continue to be involved in sports where strength and muscle mass are at a premium. Endurance athletes, female athletes, and nonathletes seeking to add strength, bulk, muscle definition, or to improve their

self-image must also be considered to be at risk. It is appropriate for pediatricians to inquire about anabolic steroid use during routine health maintenance visits because of the general health risks and the general distribution of the population at risk.

Because recognition of the anabolic steroid user is unlikely to result from drug testing or disclosure by patients or by the supplier of the drug, physicians must recognize clinical signs that suggest use. Any of the adverse effects in Table 3 may occur, but the pediatrician is most likely to note changes such as otherwise improbable gains in lean body mass, gains in muscle bulk and definition, and behavioral changes such as increased aggressiveness and/or emotional lability. The adolescent anabolic steroid user may also show advanced stages of acne on the chest and back, gynecomastia, early male-pattern baldness, jaundice, and/or testicular atrophy. Blood pressure elevations are common, as are elevated levels of total cholesterol and depressed levels of high-density lipoprotein cholesterol.

If use of anabolic steroids or other performance-enhancing substances is suspected, clinicians must respond in a manner that does not alienate the patient. Responses that are confrontational, judgmental, or in violation of doctor-patient confidentiality will quickly eliminate any opportunity to influence the patient's decision making. It is also important to understand the anabolic steroid user's perspective—that the rewards for excellence in sports or a muscular body outweigh the penalties and risks associated with anabolic steroid use.<sup>30,33</sup> A balanced, informed discussion about the benefits and risks of anabolic steroids is preferable to scare tactics or a one-sided discourse on the inconsistencies and inadequacies of the available medical literature.

The credibility gap between anabolic steroid users and medical personnel can be narrowed by honest acknowledgment that anabolic steroids can have physical effects deemed desirable and even necessary by the user. It may be helpful to distinguish common, non-life-threatening side effects (acne, gynecomastia, balding) from the more rare and potentially fatal complications such as malignancies or thrombotic phenomena.

Anabolic steroid users and potential users should be aware that many of the adverse effects of anabolic steroids may be present without obvious warning signs. Examination of the patient for hypertension, cholesterol and lipid abnormalities, and/or hepatocellular damage, even if none of these are found, can impart a strong message that anabolic steroids can have serious side effects. Testing or laboratory determination for these side effects should include a disclaimer that testing does not condone use and that a negative test does not guarantee freedom from complications.

Medical issues related to anabolic steroid use are only part of the decision-making process. Some anabolic steroid users believe that, regardless of medical consequences, steroids are necessary to be competitive. Other athletes believe that steroid use precludes fair competition and that any success an athlete achieves while using steroids is tainted.

Coaches are often influential in an athlete's decision-making process about whether to use anabolic steroids but may give ambiguous messages about what is necessary for success and what is fair in competition.

Part of drug-prevention counseling is providing a healthy alternative to drug use. Most athletes will find a way to meet their sports goals without using anabolic steroids. Athletes may need to be reminded that the health, fitness, and social benefits of sports participation can be readily met without use of performance-enhancing substances. For the athlete who is convinced that steroids are essential for success, it may be helpful to point out role models in the sports community whose success did not depend on the use of drugs.

Current clinical experience and scientific evidence support an approach to the anabolic steroid issue that minimizes preconceptions about the users, recognizes the potential benefits as well as risks of use, and maximizes informed, balanced, and open interaction with patients. There is ample need and justification for pediatric health care practitioners to be increasingly involved in the care of individuals who are using or considering use of these substances.

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