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Anabolic Steroid Abuse among Teenage Girls: An Illusory Problem?

Gen Kanayama, Matthew Boynes, James I. Hudson, Alison E. Field, and Harrison G. Pope Jr.

From the Biological Psychiatry Laboratory, McLean Hospital/Harvard Medical School, Belmont, MA 02478 (Doctors Kanayama, Hudson, Pope, and Mr. Boynes) and Channing Laboratory, Department of Medicine, Brigham and Women's Hospital and the Division of Adolescent Medicine, Children's Hospital/Harvard Medical School, 300 Longwood Avenue, Boston, Massachusetts 02115 (Dr. Field).

Abstract

Background—Recent media reports have portrayed an alarming increase in apparent anabolic-androgenic steroid (AAS) use among American teenage girls; Congress even held hearings on the subject in June 2005. We questioned whether AAS use among teenage girls was as widespread as claimed.

Methods—We reviewed four large national surveys and many smaller surveys examining the prevalence of AAS use among teenage girls. Virtually all of these surveys used anonymous questionnaires. We asked particularly whether the language of survey questions might generate false-positive responses among girls who misinterpreted the term “steroid.” We also reviewed data from other countries, together with results from the only recent study (to our knowledge) in which investigators personally interviewed female AAS users.

Results—The surveys produced remarkably disparate findings, with the lifetime prevalence of AAS use estimated as high as 7.3% among ninth-grade girls in one study, but only 0.1% among teenage girls in several others. Upon examining the surveys reporting an elevated prevalence, it appeared that most used questions that failed to distinguish between anabolic steroids, corticosteroids, and over-the-counter supplements that respondents might confuse with “steroids.” Other features in the phrasing of certain questions also seemed likely to further bias results in favor of false-positive responses.

Conclusions—Many anonymous surveys, using imprecise questions, appear to have greatly overestimated the lifetime prevalence of AAS use among teenage girls; the true lifetime prevalence may well be as low as 0.1%. Future studies can test this impression by using a carefully phrased question regarding AAS use.

1. Introduction

Many men use illicit anabolic-androgenic steroids (AAS) to gain muscle for athletics or appearance (Pope and Brower, 2000). Women, by contrast, would seem unlikely to want to use AAS, since they are less likely to desire muscularity, and also risk masculinizing effects from these drugs (Gruber and Pope 2000). Surprisingly, however, the Centers for Disease

Correspondence should be addressed to Dr. Pope at McLean Hospital, 115 Mill Street, Belmont, MA 02478; telephone number: (617) 855-2911; facsimile: (617) 855-3585; email: hpope@mclean.harvard.edu

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Control (CDC) recently reported “lifetime illegal steroid use” in 7.3% of ninth-grade American girls (CDC, 2003) – sparking media warnings of a possible crisis of AAS use among girls (Anonymous, 2005;Hohler, 2005;Johnson, 2005). In June 2005, the House Government Reform Committee of the United States Congress held a public hearing regarding AAS abuse by women and girls (U.S. Congress, 2005). Subsequent media coverage has continued to suggest, despite some criticism (Collins, 2005), that AAS use among American teenage girls is widespread (Biden, 2006;Bishop, 2005;Sandalow, 2005).

Are these concerns justified? Below, we suggest that the reported prevalence of AAS use among girls is often greatly inflated by false-positive responses to survey questions, and that true AAS use among girls is rare.

2. Review of Studies

2.1 National studies

Four large national surveys have assessed the lifetime prevalence of AAS use in American teenage girls (CDC, 2003,2005;Field et al., 2005;Johnston et al., 2005;SAMHSA, 1994) – yielding grossly discrepant estimates, ranging from 0.1% to 7.3% (Table 1). These discrepancies cannot reasonably be attributed to sampling differences, because the surveys showed no comparable differences in their prevalence estimates for other drugs, such as cannabis (Table 1). The discrepancies also cannot be explained by secular trends in the prevalence of AAS use, since all but one of the studies were performed within the last few years. Therefore, to better explain the discrepancies, we examine differences in study methodology.

2.1.1 The CDC study—The CDC surveys (CDC, 2003,2005) ask a single question about use of “steroid pills or shots without a doctor's prescription” (Figure 1). But this question has several deficiencies. First, it does not specify *anabolic-androgenic* steroids as opposed to corticosteroids; therefore a girl using, say, prednisone for poison ivy might answer positively, defeating the question's intent. Second, the phrase “without a doctor's prescription” implies that doctors typically prescribe “steroids” – whereas doctors actually almost never prescribe AAS to girls. Third, respondents may erroneously think that “steroids” are present in over-the-counter sports supplements, such as protein powders, amino acids, creatine, or supplements with names suggestive of AAS (see Table 2). Fourth, the question asks “how many times” the respondent has taken “steroids,” (i.e., “1 or 2 times,” “3 to 9 times,” etc.). But this again is misleading, because unlike other illicit drugs, AAS are not taken on individual “times,” but instead for a course measured in weeks or months (Pope and Brower, 2000). For all of these reasons, respondents may misinterpret the “steroid” question and give false-positive responses. Note that these four problems do not affect questions regarding other drugs of abuse; questions regarding, say, cocaine or marijuana are unambiguous.

False-positive responses would explain the striking decrease in CDC prevalence estimates from 2003 to 2005 (see Table 1). It might initially appear that AAS use among girls has declined over these two years – but this interpretation is fallacious, because these are *lifetime* estimates. Consider, for example, the 7.3% estimate for ninth-graders in 2003 (95% confidence interval: $\pm 2.6\%$). If no additional ninth-graders tried AAS in the following two years, then their *lifetime* prevalence in 2005, when they reached 11th grade, would still be 7.3%. But the actual 2005 figure for 11th-graders is only 2.8% (95% confidence interval: $\pm 1.1\%$). This striking difference cannot reasonably be explained by sampling differences in 2003 versus 2005, since the 95% confidence intervals for these estimates do not even overlap. More likely, the proportion of *false-positives* declined; given the extensive recent publicity about AAS, fewer students misinterpreted the term “steroid” in 2005.

2.1.2 The Monitoring the Future Study—Unlike the CDC question, the Monitoring the Future (MTF) study question (Figure 1) mentions the specific term “anabolic steroids,” and adds that “steroids” are used for muscle development (Johnston et al., 2005). Like the CDC question, however, the MTF question still misleadingly implies that doctors typically prescribe AAS, or might “tell you to take them,” and that AAS are taken on individual “times.” Also, the question does not specifically caution respondents that AAS should not be confused with corticosteroids or sports supplements. Overall, then, this question should still yield some false positives, but fewer than the CDC – and as predicted, the MTF study indeed produces lower estimates (Table 1).

2.1.3. The Growing up Today study—Unlike the CDC and MTF studies, the Growing up Today (GUT) study (Field et al., 2005) places its “steroid” question last in a series of seven questions regarding substances typically used for muscle gains, fat loss, or athletic performance (Figure 1). Therefore, having just answered the six previous questions, respondents are well cued that “anabolic/injectable steroids” refers to AAS as opposed to, say, corticosteroids. Respondents are also unlikely to confuse “steroids” with over-the-counter supplements such as protein or creatine, since they have already answered separate questions about these categories. These features should minimize false-positive responses – and therefore the GUT study’s 0.1% estimate for lifetime AAS use among teenage girls seems likely accurate.

One might argue, conversely, that the GUT study underestimates AAS use, because the phrase “anabolic/injectable steroids” might generate false-negative responses among individuals using exclusively oral AAS, and not injectable AAS. But this possibility is unlikely to cause serious error, because most AAS users do use injectable AAS, either alone or combined with oral agents (Pope and Brower, 2000). Therefore, even assuming that 50% of female AAS users used exclusively oral agents, and all of these individuals gave false-negative responses to the GUT question, the prevalence estimate would still rise only to 0.2%.

2.1.4. The National Household Survey—Unlike the previous studies, the National Household Survey (NHS) utilized trained interviewers, rather than anonymous questionnaires (SAMSHA, 1994). With an interviewer present to provide clarification and query subjects about equivocal responses, one would expect few false-positives – and indeed, for girls aged 14-19, the NHS estimated the lifetime prevalence of AAS use at only 0.1%. Even this figure might still include some false-positives, however, because approximately 95% of girls were not asked verbally about AAS, but simply answered a written questionnaire in the presence of the interviewer. Although the written question (Figure 1) appropriately uses the term “anabolic steroids,” it fails to caution that AAS should not be confused with corticosteroids or sports supplements, and it implies that AAS are drugs typically prescribed by doctors – factors conducive to false-positive responses, as discussed above. Therefore, the NHS figure, low as it is, might still overestimate of the true prevalence of AAS use in teenage girls.

It might be argued that the NHS estimate is out of date, because this survey has not assessed AAS use among teenagers since 1994. However, longitudinal data, such as the annual MTF figures (Johnston et al., 2006), show no marked rise in AAS use between 1994 and 2005 – suggesting that the 1994 NHS figures are still applicable. It might also be argued that the NHS produced false negatives because respondents were unwilling to disclose illicit AAS use to an interviewer. But this argument also seems implausible, since the NHS produced substantial prevalence estimates for other illicit drugs, such as cannabis, despite the lack of anonymity (Table 1).

In summary, upon inspecting the national studies above, it appears that among American girls 14-19, the true lifetime prevalence of AAS use is likely about 0.1%, as estimated by the GUT

and NHS studies, and that the higher estimates in the CDC and MTF studies are attributable to false-positive responses.

2.1.5. Prevalence of AAS use among boys in national studies—Our discussion above would imply, parenthetically, that prevalence estimates for AAS among boys should also be greatly inflated by false-positives in the CDC study, modestly inflated in the MTF study, and relatively free of false-positives in the GUT and NHS studies. Consistent with this prediction, lifetime prevalence estimates of AAS use for boys were 6.8% in the 2003 CDC study (9th through 12th grades combined); 3.9% in the 2004 MTF study (10th and 12th grades combined); 0.4% in the 2001 GUT study; and 1.4% in the 1994 NHS study. Thus, we would suggest that the true lifetime prevalence of AAS use among American boys aged 14-19 is likely in the range of 1% or possibly even less. It should be noted, however, that many male AAS users begin use after age 19; for example, in one recent study of 48 AAS users age 18-65 (Kanayama et al., 2003) only 15 (31%) reported AAS use prior to age 20, and in the 1991 NHS, the median reported age of onset of AAS use across genders was 18 (Yesalis et al., 1993). Thus, the lifetime prevalence of AAS use is likely higher among men in their 20s or 30s.

2.2. High-school surveys

Many additional studies have estimated the prevalence of AAS use in more local samples of teenagers. Some were restricted to boys; major studies that included girls (Durant et al., 1993,1994;Elliot et al., 2004;Faigenbaum et al., 1998;Fisher et al., 1996;Irving et al., 2002;Scott et al., 1986;Tanner et al., 1995) are summarized in Table 3. All of these studies used anonymous or confidential questionnaires; none, to our knowledge, provided an explicit definition of AAS, and none cautioned respondents that AAS should not be confused with corticosteroids or sports supplements. Several additional studies (Coker et al., 2000;Durant et al., 1995,1999;Grunbaum et al., 1998;Middleman et al., 1995;Miller et al., 2005;Zullig et al., 2001), utilized CDC data from individual regions; these studies by definition have the same flaws as the national CDC studies already discussed, and hence are omitted from Table 3. Overall, therefore, it would follow that most estimates of AAS use among high-school girls should be greatly inflated by false-positives.

A notable exception in Table 3 is the study of Elliot and colleagues (2004), who found lifetime AAS use in only 0.1% of 928 female high-school athletes. Athletes might be expected to exhibit greater AAS use than girls in general – yet Elliott and colleagues found a far lower prevalence than the other surveys of girls as a whole. There is a likely explanation for this difference: athletes, answering a questionnaire focusing on performing-enhancing substances, would rarely misinterpret the term “steroid” – thus minimizing false-positive responses. The study's results also seem unlikely to be seriously biased by false-negative responses from genuine AAS users who denied use – since respondents readily acknowledged substantial use of other drugs, such as marijuana and diet pills. Therefore, the study's 0.1% estimate for lifetime AAS use among girls seems reasonable.

2.3. Evidence from other studies involving women

Two other recent studies offer further evidence that AAS use is rare in women and even rarer in girls. Kanayama et al. (2001) gave anonymous questionnaires to 511 clients at five gymnasiums, including two “hard-core” gymnasiums frequented by competitive bodybuilders. Since AAS use is usually associated with strength training (Pope and Brower, 2000), one would expect gymnasiums, especially “hard-core” gymnasiums, to show high concentrations of AAS users. Indeed, AAS use was reported by 18 (5.4%) of 334 men, but none of 177 women.

In the other study, Gruber and Pope (2000) systematically recruited and interviewed female AAS users; this was the only published study in the last decade, to our knowledge, reporting

direct interviews of women using AAS. The investigators advertised extensively for subjects in gymnasiums – a method that had previously yielded ample numbers of male AAS users (Pope and Katz, 1988;1994) – but found only 25 female AAS users in three metropolitan areas over a two-year period. Of these, none reported AAS use prior to age 20.

Indeed, to our knowledge, no scientific paper in the last 10 years has described a girl or woman, personally interviewed, who reported AAS use prior to age 20. Considering that approximately 23,000,000 American girls reached age 20 between 1996 and 2006, and allowing that even 0.5% of these girls used AAS before age 20, then there would be 115,000 American women, presently age 20-30, who first used AAS as teenagers. If so, it would seem remarkable that none has been described in the scientific literature.

2.4. Studies from other countries

We are aware of only one national survey of teenage AAS use outside of the United States: Galduróz and colleagues (2004) studied 48,155 Brazilian students, using a survey question designed to minimize false positives – providing specific examples of nine representative AAS widely used in Brazil (Androlone, Anabolex, etc.), and asking respondents who answered “yes” to name the AAS that they had used. Only those naming a genuine AAS were scored positive. For students age 14-19, the lifetime prevalence was 3.1% for boys, but only 0.4% for girls (Galduróz, J.C.F., personal communication, 2006).

Two other large overseas studies, though not national, are also instructive. Nilsson et al. (2001) surveyed 5827 students aged 16-17 in a county in Sweden, using an instrument that included descriptive information to clarify the term “anabolic steroids” (Nilsson, S., personal communication, 2006). Although 84 (2.9%) of the 2785 boys reported AAS use, no cases were found among the 3042 girls. By contrast, Handelsman and Gupta (1997) surveyed 13,355 high-school students in southeastern Australia and reported AAS use in 3.2% of boys and 1.2% of girls. The Australian questionnaire, however, exhibited many of the same deficits as the CDC questionnaire described above, namely asking about use of “steroids” without cautioning respondents that “steroids” should not be confused with corticosteroids or sports supplements. Thus the Australian survey, unlike the Brazilian and Swedish surveys, likely generated many false-positive responses.

3. Conclusions

We believe that quoted prevalence estimates of AAS use are often greatly inflated by false-positive responses to imprecise questions regarding “steroids” on anonymous questionnaires. Our analysis suggests that the true lifetime prevalence of AAS use among American teenage girls is well below 0.5%, and possibly only 0.1%. This impression should be tested in subsequent surveys using questions carefully designed to eliminate false-positive responses as described above. Ideally, such questions should first be tested and validated via follow-up interviews. However, since AAS use is uncommon, a fully adequate validation study might require a denominator of thousands of respondents, making it impractical. Nevertheless, false-positive responses could certainly be minimized by formulating survey questions that 1) caution respondents that AAS should not be confused with corticosteroids or over-the-counter nutritional supplements; 2) provide examples of commonly used AAS; and 3) require respondents to name the AAS that they have used, as in the Brazilian study above.

These conclusions have important implications for public health policy. If AAS use is indeed rare among teenage girls, then it may be irrational to devote extensive resources in this area; resources targeted at prevention of AAS use may be better concentrated on males, for whom the prevalence and hazards of AAS use are better documented.

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Survey	Question
Centers for Disease Control Youth Risk Behavior Surveillance, 2003; 2005	<p>During your life, how many times have you taken steroid pills or shots without a doctor's prescription?</p> <p>☐ 0 times ☐ 1 or 2 times ☐ 3 to 9 times ☐ 10 to 19 times ☐ 20 to 39 times ☐ 40 or more times</p>
Monitoring the Future Study, 2004	<p>Steroids, or anabolic steroids, are sometimes prescribed by doctors to promote healing from certain types of injuries. Some athletes, and others, have used them to try to increase muscle development. On how many occasions (if any) have you taken steroids on your own--that is, without a doctor telling you to take them, in your lifetime?</p> <p>☐ 0 Occasions ☐ 1-2 Occasions ☐ 3-5 Occasions ☐ 6-9 Occasions ☐ 10-19 Occasions ☐ 20-39 Occasions ☐ 40 or More</p>
Growing up Today Study (2001)^a	<p>During the past year, how often did you use any of the following products?</p> <p>Protein powder or shake ☐never ☐less than monthly ☐monthly ☐weekly ☐daily</p> <p>Weight loss shakes/drinks ☐never ☐less than monthly ☐monthly ☐weekly ☐daily</p> <p>Creatine ☐never ☐less than monthly ☐monthly ☐weekly ☐daily</p> <p>Amino Acids, HMB ☐never ☐less than monthly ☐monthly ☐weekly ☐daily</p> <p>DHEA ☐never ☐less than monthly ☐monthly ☐weekly ☐daily</p> <p>Growth Hormone ☐never ☐less than monthly ☐monthly ☐weekly ☐daily</p> <p>Anabolic/Injectable steroids ☐never ☐less than monthly ☐monthly ☐weekly ☐daily</p>
National Household Survey, 1994	<p>"Have you ever, even once, used anabolic steroids, without your own prescription from a doctor?"</p> <p>☐ YES, I have used anabolic steroids without my own prescription from a doctor ☐ NO, I have never used anabolic steroids without my own prescription from a doctor</p>

Fig 1.

Questions Regarding AAS use in Four National Surveys.

^aNote that figures shown here are for girls studied in 2001, whereas the most recent publication of the Growing up Today Study presents data from 1999.

Table 1

National Studies of Anabolic Steroid Use in Girls

Study	Method	Overall sample	Subgroup	N	Prevalence of AAS Use		Lifetime prevalence of cannabis use
					Lifetime	Past Year	
CDC Youth Risk Behavior Surveillance, 2003	Anonymous questionnaire	National sample of high school students	9th grade girls	1809	7.3%		28.1%
			10th grade girls	1860	5.1%		36.4%
			11th grade girls	1938	4.3%		43.5%
			12th grade girls	1922	3.3%		44.9%
CDC Youth Risk Behavior Surveillance, 2005	Anonymous questionnaire	National sample of high school students	9th grade girls	1735	4.8%		27.8%
			10th grade girls	1780	2.5%		35.7%
			11th grade girls	1821	2.8%		39.4%
			12th grade girls	1817	2.3%		42.8%
Monitoring the Future Study, 2004	Anonymous questionnaire	National sample of high school students	8th grade Girls	8708	1.6%	1.0%	15.0%
			10th grade Girls	8342	1.4%	0.9%	32.8%
			12th grade Girls	7370	2.3%	1.7%	42.6%
			Girls 14-19	3427	0.1%	0.1%	22.6%
Growing up Today Study, 2001 ^a	Anonymous questionnaire	Children of participants in Nurses Health Study					
National Household Survey, 1994	Questionnaire/Interview ^b	National population sample	Girls 14-19	2062	0.1%	0.1%	21.4%

^a Note that figures shown here are for girls studied in 2001, whereas the most recent publication of the Growing up Today Study (Field et al., 2005) presents data from 1999.

^b See discussion in text

Table 2

Examples of Genuine of AAS vs. Sports Supplements

Genuine AAS (illicit, federally controlled substances)		Sports Supplements (licit, over-the counter, containing no AAS)	
Chemical name	Brand names		Examples of Brand Names
testosterone	Sustanon Duratest Depo-testosterone	creatine	Creavescent Anavol Betagen Mass Stack Mass Cycle Andro
nandrolone decanoate methenolone	Deca-durabolin Primobolan	adrenal steroids ^a	Nor Andro Andro-Stack 3 Andro Xtreme
methandienone	Dianabol Anabol Anavar	other supplements	Lipovar Anator Anadrox Tribex
oxandrolone	Anadrol		Anabolic Formula Metabolol
oxymetholone	Metandren Mesteron		Methyl-Masterdrol Hi-Tech Anavar Hi-Tech Dianabol
methyltestosterone	Finaject Parabolan		Hi-Tech Metanabol Doctor's Testosterone Gel
trenbolone			
stanazolol	Winstrol		

^a Adrenal steroids such as androstenedione and its relatives, which have only weak anabolic activity, were available over the counter until January 2005, but became federally controlled substances under the Anabolic Steroid Control Act of 2004. Only DHEA (dehydroepiandrosterone) is still legally available in supplement stores.

Table 3
Anonymous Surveys of American High-School Students that Report the Prevalence of Anabolic Steroid Use in Girls

Study	Location	Sample	N	Reported lifetime prevalence of AAS Use	Question regarding "steroids"
Durant et al., 1993	Georgia	ninth-grade girls	919	1.9%	CDC question ^d
Tanner et al., 1995	Colorado	high-school girls	3497	1.3%	Have you ever used anabolic steroids?
Scott et al., 1996	Nebraska	middle- and high-school girls	2522	0.8% ^b	information not supplied
Fisher et al., 1996	New York City	girls in high-school gym class	461 ^c	4% ^c	information not supplied
Faigenbaum et al., 1998	Massachusetts	middle-school girls	499	2.8%	Have you ever taken steroids?
Irving et al., 2002	Minnesota	middle-school girls	740 ^d	5.7% ^e	How often have you use steroids in order to gain muscle during the past year?
		high-school girls	1430 ^d	1.4% ^e	
Elliot et al., 2004	Oregon, Washington	female high-school athletes	928	0.1%	"similar to" MTF and CDC questions

^a Question was "How many times have you taken steroid pills or shots without a doctor's prescription?"

^b Use of AAS in past 30 days

^c Exact number not supplied

^d Estimated number; exact number not supplied

^e Use of AAS in past 12 months