

Criminality Among Individuals Testing Positive for the Presence of Anabolic Androgenic Steroids

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Context: Observations suggest that the use of anabolic androgenic steroids (AAS) may trigger uncontrolled, violent rage. Other observations indicate that certain groups of criminals may use AAS with the intention of being capable of committing crime more efficiently.

Objective: To examine the proposed association between the use of AAS and criminality.

Design: A controlled retrospective cohort study of registered criminal activity among individuals tested for AAS use during the period of January 1, 1995, to December 31, 2001.

Setting: All individuals in Sweden who were tested for AAS use during this period. These individuals were referred for testing from both inpatient and outpatient clinics as well as from centers for treatment of substance abuse.

Participants: Individuals testing positive for AAS (n=241), with those testing negative for AAS during the same period (n=1199) serving as the control group.

Main Outcome Measures: The ratios (expressed as relative risk [RR]) of the incidences of several categories of crime in the 2 study groups.

Results: The risk of having been convicted for a weapons offense or fraud was higher among individuals testing positive for AAS than among those testing negative (RR, 2.090 and 1.511, respectively; 95% confidence interval [CI], 1.589-2.749 and 1.208-1.891, respectively) whereas there were no significant differences with respect to violent crimes (RR, 1.116; 95% CI, 0.981-1.269) or crimes against property (RR, 0.942; 95% CI, 0.850-1.044). When patients referred from substance abuse centers were excluded, a lower risk for crimes against property was observed for the individuals who tested positive for AAS (RR, 0.761; 95% CI, 0.649-0.893) and the risk for fraud in the 2 groups was equalized (RR, 1.117; 95% CI, 0.764-1.635). The increased risk for a weapons offense among the individuals testing positive for AAS remained virtually unchanged.

Conclusions: In addition to the impulsive violent behavior previously shown to be related to AAS use, such use might also be associated with an antisocial lifestyle involving various types of criminality. However, the existence and nature of this possible association remain unclear and call for further investigation.

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NONPRESCRIBED USE OF anabolic androgenic steroids (AAS) has been associated with a variety of psychiatric complications and behavioral changes.^{1,2} Case reports or survey studies of groups using AAS (eg, bodybuilders) have described hypomania or manic episodes,^{3,4} depression or suicide,⁴⁻⁸ psychotic episodes,³ and increased aggressiveness and hostility.^{9,10} This aggressiveness appears to occasionally trigger violent behavior,^{4,11-14} sometimes even including homicide.^{9,12,14,15} In addition, at least 3 randomized placebo-controlled studies, described in 5 published articles,^{10,16-19} have revealed hyperactive, manialike symptoms in individuals receiving high-dose AAS treatment, suggesting that these substances may exert pathological effects on mood and cogni-

tion (eg, euphoria, sexual arousal, irritability, mood swings, violent feelings, hostility, distractibility, forgetfulness, and confusion) in certain individuals. In contrast, in at least 1 other randomized placebo-controlled study²⁰ involving comparable doses of AAS, no effects resembling mania were observed.

The proposal that AAS may precipitate violent behavior has motivated 2 attempts at epidemiological confirmation. Of the 133 individuals incarcerated for violent crimes who were studied by Pope et al,²¹ only 2 maintained that their violence was a consequence of AAS intake. However, in this study, the investigators themselves emphasized that they had encountered several methodological difficulties. First, selection bias was likely to have occurred, as approximately half of the incarcerated individuals who were approached declined to

be interviewed. Second, there were indications of various forms of information bias, eg, 2 incarcerated individuals with conspicuous bodily signs of AAS use denied such use. In a Swedish study,²² 66 individuals arrested for violent crimes were asked to participate in an interview and urine analysis regarding the use of AAS. Of the 50 individuals (76%) who agreed to participate, none had AAS in his urine. However, the high rate of nonparticipation again rendered these results inconclusive.

A recent evaluation of the toxicological findings for homicide victims in Stockholm, Sweden, revealed that all of the victims who tested positive for AAS had been shot whereas victims positive for other drugs and/or alcohol also had a variety of other types of homicide (eg, stabbing, blunt trauma, or asphyxiation).²³ Fatal shootings in Sweden are usually related to conflicts among criminals. This observation, together with an earlier observation that bank robbers use AAS prior to committing their crime,¹² led us to hypothesize that the use of AAS may be associated not only with impulsive, uncontrolled violence of the type known as 'roid rage'²⁴ but also with planned, premeditated violence among criminals. In summary, despite the lack of epidemiological confirmation, the scientific literature does suggest that the use of AAS involves an increased risk for uncontrolled violent behavior in certain individuals and that AAS are frequently used by individuals involved in heavy types of criminality. The aim of our investigation was to test these hypotheses by analyzing registered criminality, with a focus on violent crime and weapons offenses, among a cohort of individuals who were found to have self-administered nonprescribed AAS.

METHODS

SELECTION OF SUBJECTS

The initial study population consisted of 1440 individuals (1396 [97%] of whom were male) who were tested for AAS at the Doping Laboratory, Huddinge University Hospital, Huddinge, Sweden (the only facility in Sweden that provides screening for such compounds) between January 1, 1995, and December 31, 2001. Referrals to this laboratory are made from inpatient and outpatient clinics (including centers for treatment of substance abuse and forensic psychiatric facilities in addition to general practitioners and social services) as well as from care units at police and customs stations throughout Sweden.

These individuals were divided into 2 groups: those who tested positive for AAS on at least 1 occasion during the study period ($n=241$) and those who never tested positive during this same period ($n=1199$). Nineteen individuals who were referred from the centers for treatment of abuse of doping agents but never tested positive for AAS during the study period were excluded, leaving 1180 individuals in the AAS-negative group. The AAS-positive and AAS-negative groups were compared with respect to age at the beginning of the study period, sex, and the origin of their referral to the Doping Laboratory.

SOURCES AND CATEGORIZATION OF THE DATA

The case records at the Doping Laboratory provided the social security numbers (from which age and sex are apparent) of those

tested for AAS as well as information concerning the institutions responsible for referral and the results of the analyses. Since 1973, all criminal convictions of individuals older than 15 years in Sweden are archived routinely in the criminal register of the Swedish National Police Board. From this register, we collected the criminal records of our individuals from 1995 to 2001 with the use of their social security numbers. These register analyses were approved by the regional ethical committee of Karolinska Institute, Stockholm. Subsequently, the different types of offenses were sorted into a number of categories, 5 of which were selected for the evaluation here: (1) crimes of violence (homicide, attempted homicide, manslaughter, assault, aggravated assault, causing bodily harm, robbery, serious case of robbery, unlawful detention, assaulting or threatening a civil servant); (2) weapons offenses (crimes against the laws concerning firearms); (3) crimes against property (unlawful dispossession, attempted theft, theft, serious case of theft, receiving stolen goods, pilfering, theft of a vehicle); (4) fraud (attempted fraud, fraud, gross fraud, embezzlement, forgery of documents, use of forged documents, unlawful use of documents, crimes against the tax and accountancy laws, fraudulent behavior); and (5) sexual offenses (rape, attempted rape, molestation).

The first 2 of these groups were evaluated to test our hypothesis. The third and fourth groups were evaluated to obtain a more comprehensive overview of the patterns of criminality among our individuals. The fifth group was evaluated in light of a report describing the use of AAS as a risk factor for commission of a sexual offense²⁵ as well as descriptions of enhanced libido in connection with the use of AAS.^{26,27}

STATISTICAL ANALYSES

Because a history of drug abuse is associated with a high risk for criminality,²⁶ we performed 2 types of comparisons: one included individuals referred from substance abuse centers, and the other excluded these individuals. Criminality in the AAS-positive and AAS-negative groups was assessed on the basis of the number of separate convictions for the 5 different types of offenses described earlier. The number of individuals in each group was multiplied by 6 to obtain the number of person-years at risk, and the total number of convictions during the study period was subsequently divided by this value to calculate the incidence of crime during this same period. Thereafter, the ratios (expressed as relative risk [RR]) of these incidences were calculated using the individuals who tested negative for AAS as the reference group (denominator). The 95% confidence intervals (CIs) for the incidences of conviction (assuming a Poisson distribution) and for the ratio of these incidences (using the approximation of normal distribution) were determined. Differences in the numbers of convicted individuals were analyzed using the χ^2 test, with a $P<.05$ being considered statistically significant.

RESULTS

At the beginning of the study period, the mean (SD) age of the individuals in the AAS-positive group was 20.5 (6.4) years compared with 20.0 (6.9) years for the AAS-negative group ($t=1.05$; $P=.29$). The proportion of women in both groups was low, ie, 3 (1%) of 241 individuals testing positive for AAS and 41 (3%) of 1180 testing negative for AAS. The referrals to the Doping Laboratory came primarily from centers for treatment of substance abuse and from nonpsychiatric inpatient and outpatient clinics, including primary health care (**Table 1**). The mean (range)

Table 1. Referrals From Institutions to the Doping Laboratory Among Individuals Testing Positive and Negative for AAS

Referring Institution	Individuals Testing Positive for AAS, No. (%) (n = 241)	Individuals Testing Negative for AAS, No. (%) (n = 1180)
Centers for treatment of abuse of doping agents	37 (15)	0
Centers for treatment of substance abuse	93 (39)	379 (32)
Centers for somatic care (inpatient and outpatient clinics and primary health care)	53 (22)	445 (37)
Centers for psychiatric care (inpatient and outpatient clinics)	16 (7)	196 (16)
Police or social services	32 (13)	91 (8)
Other	10 (4)	69 (6)

Abbreviation: AAS, anabolic androgenic steroids.

Table 2. Incidences and Relative Risks for Conviction for Criminal Offenses Among Individuals Testing Positive and Negative for AAS*

Type of Crime	Incidence (95% CI)		Relative Risk (95% CI)†
	AAS-Positive Group	AAS-Negative Group	
Violent crimes	0.196 (0.173-0.219)	0.175 (0.166-0.185)	1.116 (0.981-1.269)
Weapons offenses	0.050 (0.039-0.062)	0.024 (0.021-0.028)	2.090 (1.589-2.749)
Crimes against property	0.300 (0.272-0.328)	0.319 (0.305-0.332)	0.942 (0.850-1.044)
Fraud	0.069 (0.056-0.083)	0.046 (0.041-0.051)	1.511 (1.208-1.891)

Abbreviations: AAS, anabolic androgenic steroids; CI, confidence interval.

*The convictions for criminal offenses were during the study period from January 1, 1995, to December 31, 2001. The AAS-positive group was used as the reference group.

†The relative risk was calculated for the AAS-positive group vs the AAS-negative group.

number of AAS analyses performed during the study period was 3.0 (1-22) analyses for the AAS-positive group and 1.2 (1-14) analyses for the AAS-negative group.

Comparison of the incidences of conviction for our chosen types of crimes between individuals testing positive and negative for AAS during the study period revealed that the risk of having been convicted for a weapons offense or fraud was significantly higher among individuals who tested positive for AAS (RR, 2.090 and 1.511, respectively; 95% CI, 1.589-2.749 and 1.208-1.891, respectively) (**Table 2**). When the individuals referred to the Doping Laboratory from centers for treatment of substance abuse were excluded, the risk of having been convicted for a weapons offense remained significantly higher for individuals who tested positive for AAS (RR, 2.130; 95% CI, 1.456-3.116) whereas the risk of having been convicted for crimes against property became significantly lower in the AAS-positive group (RR, 0.761; 95% CI, 0.649-0.893) and the difference between the AAS-positive and AAS-negative groups with respect to fraud was eliminated (RR, 1.117; 95% CI, 0.764-1.635) (**Table 3**).

When the proportions of individuals convicted for different types of crimes in our 2 study groups were compared, weapons offenses were clearly and highly significantly overrepresented in the AAS-positive group ($P = .002$) (**Table 4**). This difference remained statistically significant even when the subjects referred to the Doping Laboratory from centers for treatment of substance abuse were excluded ($P = .04$) (**Table 5**). With respect to conviction for sexual crimes, there was no statistically significant difference between the AAS-positive (1 conviction) and AAS-negative (11 convictions) groups during the study period ($P = .68$).

COMMENT

The most obvious limitation of our investigation is that the number of unregistered crimes is unknown and may be unevenly distributed between the AAS-positive and AAS-negative groups. Another limitation is that we cannot know with any certainty whether those who tested positive for AAS are representative of all users of AAS. It may well be that those who experience adverse effects in connection with AAS use are tested more frequently simply because they seek medical attention or receive attention from the judicial system more often.

However, similar proportions of individuals in the AAS-positive and AAS-negative groups were referred to the Doping Laboratory by similar centers (with the exception of the center for treatment of abuse of doping agents), indicating that the selection bias associated with the referral of patients for AAS analyses was minor. For example, the total proportion of individuals referred from centers for treatment of substance abuse and psychiatric care were virtually the same in both groups. Furthermore, the individuals in the AAS-positive and AAS-negative groups were highly similar with respect to both age and the percentages of men and women. Thus, with certain reservations for the first limitation discussed earlier, our findings and conclusions regarding AAS and criminality in a population that probably incorporates a number of risk factors for criminality would appear to be reasonably valid.

Yet another limitation is that the testing was not performed often enough to allow us to conclude that the individuals who tested negative for AAS were actually nega-

Table 3. Incidences and Relative Risks for Conviction for Criminal Offenses Among Individuals Testing Positive and Negative for AAS Excluding Individuals Referred to the Doping Laboratory From Centers for Treatment of Substance Abuse*

Type of Crime	Incidence (95% CI)		Relative Risk (95% CI)†
	AAS-Positive Group	AAS-Negative Group	
Violent crimes	0.169 (0.142-0.196)	0.149 (0.138-0.160)	1.135 (0.952-1.354)
Weapons offenses	0.042 (0.028-0.055)	0.020 (0.016-0.024)	2.130 (1.456-3.116)
Crimes against property	0.193 (0.164-0.221)	0.253 (0.239-0.267)	0.761 (0.649-0.893)
Fraud	0.036 (0.024-0.049)	0.032 (0.027-0.037)	1.117 (0.764-1.635)

Abbreviations: AAS, anabolic androgenic steroids; CI, confidence interval.

*The convictions for criminal offenses were during the study period from January 1, 1995, to December 31, 2001. The AAS-positive group was used as the reference group.

†The relative risk was calculated for the AAS-positive group vs the AAS-negative group.

Table 4. Comparison of Individuals Convicted for Criminal Offenses Among Subjects Testing Positive and Negative for AAS*

Type of Crime	Individuals in AAS-Positive Group Convicted for Criminal Offense, No. (%) (n = 241)†	Individuals in AAS-Negative Group Convicted for Criminal Offense, No. (%) (n = 1180)†	P Value	χ ² Statistic
Violent crimes	90 (37)	396 (34)	.29	1.111
Weapons offenses	33 (14)	87 (7)	.002	9.538
Crimes against property	88 (37)	407 (34)	.60	0.277
Fraud	37 (15)	134 (11)	.10	2.654

Abbreviation: AAS, anabolic androgenic steroids.

*The convictions for criminal offenses were during the study period from January 1, 1995, to December 31, 2001.

†Some individuals did not commit any crime and others committed several types of crime. Therefore, the sums of the numbers in the columns differ from the sample sizes.

Table 5. Comparison of Individuals Convicted for Criminal Offenses Among Subjects Testing Positive and Negative for AAS Excluding Individuals Referred to the Doping Laboratory From Centers for Treatment of Substance Abuse*

Type of Crime	Individuals in AAS-Positive Group Convicted for Criminal Offense, No. (%) (n = 167)†	Individuals in AAS-Negative Group Convicted for Criminal Offense, No. (%) (n = 887)†	P Value	χ ² Statistic
Violent crimes	48 (29)	226 (25)	.43	0.618
Weapons offenses	17 (10)	49 (6)	.04	4.426
Crimes against property	46 (28)	218 (25)	.48	0.511
Fraud	21 (13)	70 (8)	.40	0.721

Abbreviation: AAS, anabolic androgenic steroids.

*The convictions for criminal offenses were during the study period from January 1, 1995, to December 31, 2001.

†Some individuals did not commit any crime and others committed several types of crime. Therefore, the sums of the numbers in the columns differ from the sample sizes.

tive for AAS throughout the entire study period. Thus, the statistical power may have been reduced by the presence of unidentified AAS users in the AAS-negative group. The fact that our calculations are based on the assumption that the individuals testing positive for AAS at some point during the study period continued such use during this entire period may also have led to an underestimation of the effects of AAS, as it is reasonable to believe that a number of individuals in this group only received AAS during part of the period. If this is indeed the case, the differences observed here may actually be more pronounced than they appear to be.

The clearest finding of our study is that convictions for weapons offenses were approximately twice as common among individuals testing positive for AAS as among

those testing negative, irrespective of whether individuals referred to the Doping Laboratory from centers for treatment of substance abuse were excluded from the calculations. Furthermore, the proportion of individuals convicted for this type of crime was approximately twice as high among the AAS-positive group. One possible explanation for this finding might be that criminals involved in heavy types of crime, such as armed robbery or collection of crime-related debts, derive an advantage from being muscular and/or having a heavy build. The well-documented increase in aggressiveness associated with AAS use^{9,28} might also be advantageous in carrying out premeditated crimes against people. In this context, it is also of interest to note that the use of AAS has been associated with low clinical ratings of empathy.²⁹

With regard to the relationship between AAS use and violence, there were no statistically significant differences between users and nonusers with respect to either the incidence of convictions or the proportion of individuals convicted. Considering that increased aggressiveness and feelings of hostility are among the adverse effects most frequently associated with the use of AAS,²⁸ together with previous observations suggesting that the use of AAS may occasionally trigger violent acts in individuals not previously known to have such tendencies,¹⁵ this finding is somewhat surprising. However, the descriptions concerning the possible precipitation of violent behavior by AAS are anecdotal, and to our knowledge, no reliable data from systematic investigations of this issue have been published.

Furthermore, other observations suggest that violence associated with AAS use is often related to other risk factors as well. For example, in an earlier study,¹² 11 of 14 violent perpetrators characterized by current or recently discontinued use of AAS were drunk when they committed their acts of violence. In this same study, 8 of the 9 subjects who had undergone forensic psychiatric examination were diagnosed as exhibiting various psychiatric disorders (primarily personality disorders), an association that has also been demonstrated for substance abuse in general.³⁰ Thus, it could be that the use of AAS does not normally lead to acts of violence by individuals lacking other risk factors for such behavior. Because such risk factors for violence were probably relatively common among the individuals investigated here, the observed similarity in the incidences of violent crime and the proportions of individuals convicted for such crimes among AAS users and nonusers might reflect an overrepresentation of individuals with psychiatric disorders and/or other substance abuse in both of these groups, obscuring the impact of AAS use alone on violent behavior. At the same time, the possible existence of AAS users in the control group might have resulted in an underestimation of AAS-related violence.

As mentioned earlier, the use of AAS has been proposed to cause extremely violent outbursts of anger, so-called 'roid rage.^{8,12,24} Unfortunately, Swedish criminal records do not describe the nature of the violence involved in a violent crime. Thus, our investigation cannot reveal possible qualitative differences in the violent actions of the individuals in the 2 groups, eg, unusually vicious assaults by individuals testing positive for AAS.

When subjects referred to the Doping Laboratory from centers for treatment of substance abuse were excluded from the calculation, the incidence of crimes against property dropped from 0.30 to 0.19 convictions per person-year among the individuals in the AAS-positive group but only from 0.32 to 0.25 convictions per person-year among those in the AAS-negative group. The varying extent of these reductions resulted in a statistically significant lower incidence of crime against property for AAS users as compared with nonusers. This observation, together with a similar reduction in the total number of individuals convicted for this type of crime, demonstrates that a large proportion of the crimes against property were committed by individuals addicted to drugs with or without the misuse of AAS. It also indicates the existence of a sub-

population of individuals testing positive for AAS who do not use other drugs and who commit relatively few crimes against property. It might well be that many individuals in this subpopulation were referred from the center for treatment of abuse of doping agents, as only patients who voluntarily seek care for their AAS misuse are served by this clinic. Perhaps this subpopulation consists of AAS users with a relatively high socioeconomic status compared with individuals addicted to drugs in general, a group whose existence has previously been documented in the United States.³¹

Relatively few individuals were convicted of fraud, and the reduction in the proportions of these subjects in the AAS-positive and AAS-negative groups observed after the exclusion of patients referred from substance abuse centers was similar. However, this reduction was clearly more pronounced in the AAS-positive group, as it eliminated the statistically significant difference between the groups observed when referrals from substance abuse centers were included. These findings indicate that certain individuals who combined the use of AAS with other drugs were particularly prone to commit fraud, which again might indicate that there are different subpopulations in the AAS-using population.

Some investigations have found that enhanced libido is a side effect of AAS use,^{26,27} which, together with an increase in aggressiveness^{9,28} and a decrease in impulse control,⁹ might make AAS use a risk factor for sexual violence. Indeed, 1 study²⁵ did conclude that such use increases risk for sexual aggression. However, no such relationship was apparent in our study, suggesting that the use of AAS usually plays a subordinate role among the many factors leading to sexual assault.

In conclusion, our findings indicate that the use of AAS is associated not only with impulsive antisocial behavior but also with an antisocial lifestyle involving various types of criminality, some of which require preparation and planning, ie, are of a nonimpulsive nature. Although our results suggest that the misuse of AAS in society probably has little influence on the number of violent crimes committed, the design of our study does not allow any conclusions to be drawn regarding the proposed ability of AAS to aggravate violence. Further evaluation of the motives for and consequences of AAS use by criminals is required.

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REFERENCES

1. Hall RCV, Hall RCV, Chapman MJ. Psychiatric complications of anabolic steroid abuse. *Psychosomatics*. 2005;46:285-290.
2. Hall RCV, Hall RCV. Abuse of supraphysiologic doses of anabolic steroids. *South Med J*. 2005;98:550-555.

3. Freinhar JP, Alvarez W. Androgen-induced hypomania. *J Clin Psychiatry*. 1985; 46:354-355.
4. Pope HG, Katz DL. Psychiatric and medical effects of anabolic-androgenic steroid use: a controlled study of 160 athletes. *Arch Gen Psychiatry*. 1994;51: 375-382.
5. Pärssinen M, Kujala U, Vartiainen E, Sarna S, Seppälä T. Increased premature mortality of competitive powerlifters suspected to have used anabolic agents. *Int J Sports Med*. 2000;21:225-227.
6. Thiblin I, Lindquist O, Rajs J. Cause and manner of death among users of anabolic androgenic steroids. *J Forensic Sci*. 2000;45:16-23.
7. Allnutt S, Chaimowitz G. Anabolic steroid withdrawal depression: a case report. *Can J Psychiatry*. 1994;39:317-318.
8. Elofson G, Elofson S. Steroids claimed our son's life. *Phys Sportsmed*. 1990;18: 15-16.
9. Corrigan B. Anabolic steroids and the mind. *Med J Aust*. 1996;165:222-226.
10. Kouri EM, Lukas SE, Pope HG, Oliva PS. Increased aggressive responding in male volunteers following the administration of gradually increasing doses of testosterone cypionate. *Drug Alcohol Depend*. 1995;40:73-79.
11. Thiblin I, Pärkkö T. Anabolic androgenic steroids and violence. *Acta Psychiatr Scand Suppl*. 2002;(412):125-128.
12. Thiblin I, Kristiansson M, Rajs J. Anabolic androgenic steroids and behavioural patterns among violent offenders. *J Forensic Psychiatry*. 1997;8:299-310.
13. Schulte HM, Hall MJ, Boyer M. Domestic violence associated with anabolic steroid abuse. *Am J Psychiatry*. 1993;150:348.
14. Conacher GN, Workman DG. Violent crime possibly associated with anabolic steroid use. *Am J Psychiatry*. 1989;146:679.
15. Pope HG, Katz DL. Homicide and near-homicide by anabolic steroid users. *J Clin Psychiatry*. 1990;51:28-31.
16. Su TP, Pagliaro M, Schmidt PJ, Pickar D, Wolkowitz O, Rubinow DR. Neuropsychiatric effects of anabolic steroids in normal male volunteers. *JAMA*. 1993; 269:2760-2764.
17. Yates WR, Perry PJ, MacIndoe J, Holman T, Ellingrod V. Psychosexual effects of three doses of testosterone cycling in normal men. *Biol Psychiatry*. 1999; 45:254-260.
18. Pope HG Jr, Kouri EM, Hudson JI. Effects of supraphysiologic doses of testosterone on mood and aggression in normal men. *Arch Gen Psychiatry*. 2000; 57:133-140.
19. Daly RC, Su TP, Schmidt PJ, Pickar D, Murphy DL, Rubinow DR. Cerebrospinal fluid and behavioral changes after methyltestosterone administration. *Arch Gen Psychiatry*. 2001;58:172-177.
20. Tricker R, Casaburi R, Storer TW, Clevenger B, Berman N, Shirazi A, Bhasin S. The effects of supraphysiological doses of testosterone on angry behavior in healthy eugonadal men: a clinical research center study. *J Clin Endocrinol Metab*. 1996; 81:3754-3758.
21. Pope HG Jr, Kouri EM, Powell KF, Campbell C, Katz DL. Anabolic-androgenic steroid use among 133 prisoners. *Compr Psychiatry*. 1996;37:322-327.
22. Isacsson G, Garle M, Ljung EB, Asgård U, Bergman U. Anabolic steroids and violent crime: an epidemiological study at a jail in Stockholm, Sweden. *Compr Psychiatry*. 1998;39:203-205.
23. Thiblin IB, Petersson AK. Changing patterns of drug use among homicide victims. *Scand J Forensic Sci*. 2005;1:1-24.
24. Hallagan JB, Hallagan LF, Snyder MB. Anabolic-androgenic steroid use by athletes. *N Engl J Med*. 1989;321:1042-1045.
25. Borowsky IW, Hogan M, Ireland M. Adolescent sexual aggression: risk and protective factors. *Pediatrics*. 1997;100:E7.
26. Moss HB, Panzak GL, Tarter RE. Sexual functioning of male anabolic steroid abusers. *Arch Sex Behav*. 1993;22:1-12.
27. Strauss RH, Wright HE, Finerman GAM, Catlin DH. Side effects of anabolic steroids in weight-trained men. *Phys Sportsmed*. 1983;11:87-96.
28. Trenton AJ, Currier GW. Behavioural manifestations of anabolic steroid use. *CNS Drugs*. 2005;19:571-595.
29. Porcerelli JH, Sandler BA. Narcissism and empathy in steroid users. *Am J Psychiatry*. 1995;152:1672-1674.
30. Littlejohn C. Links between drug and alcohol misuse and psychiatric disorders. *Nurs Times*. 2005;101:34-37.
31. Arvary D, Pope HG. Anabolic-androgenic steroids as a gateway to opioid dependence. *N Engl J Med*. 2000;342:1532.