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Dual use of anabolic-androgenic steroids and narcotics in Sweden

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ABSTRACT

Background: Anabolic-androgenic steroids (AAS) have long been used by body-builders seeking to increase muscle size, strength and beauty. AAS are sometimes used together with narcotic agents and are thought to serve as a gateway to narcotic substance use, but this theory has not yet been substantiated clinically or sociologically.

Methods: Mandatory interviews were carried out with individuals ($n=56$) suspected of infringement of the narcotic laws in Sweden with confiscated and/or confirmed use of AAS. Data were collected over 12 months.

Results: Seventy-three percent of subjects with confirmed use of AAS were also using narcotic substances. The use of AAS was preceded by the use of narcotic agents in 55% of subjects. Only one-fifth of the subjects in the study had used AAS before using narcotic agents.

Conclusion: Co-use of AAS and narcotic agents is frequent among young people taken into custody for criminal activity and investigated by the police in Sweden. The study does not lend support to the hypothesis that AAS are commonly a gateway drug to narcotic use.

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1. Introduction

According to the studies in Western societies, Japan and Jordan, the prevalence of AAS use among high school and college students ranges from 1 to 5% (Wanjek et al., 2007; Nilsson et al., 2001; Pallesen et al., 2006; Rachoń et al., 2006; Tahtamouni et al., 2008; Takahashi et al., 2007). Men, by far the most common users of AAS (Brower, 2002; Kanayama et al., 2009a,b), are attracted to the drugs because supraphysiologic doses of AAS increase fat-free mass, muscle size and strength (Bhasin et al., 1996), effects that are further enhanced by strength training. Dependence on AAS seems to develop in two stages: initially, a psychological dependence develops with perceived improvements in personal appearance, and later a physiological dependence develops when CNS-mediated reward systems are activated (Brower, 2002).

Side effects, however, such as gynecomastia, acne, hypercholesterolemia, hypertension, myocardial hypertrophy, testicular atrophy and fluid retention are common (Takahashi et al., 2007; Hall, 2005; Wood, 2004), as well as psychological side effects including psychosis, affective symptoms, suicide and even homicide (Pope and Katz, 1987, 1988; Conacher and Workman, 1989; Brower et al., 1989). Although AAS appear to act through a common pathway for narcotic agents, the mesolimbic dopamine

system (Wood, 2004) AAS themselves do not have the pharmacological effects of psychoactive agents such as cocaine or heroin (Fingerhood et al., 1997) but instead resemble other mild reinforcers such as caffeine, nicotine or benzodiazepines (Wood, 2004).

The risks of AAS use are compounded by their frequent co-use with other medicines and even with narcotic agents (Kanayama et al., 2009a,b). Previous research has uncovered associations between AAS use and the use of cocaine, cannabis, amphetamine, LSD (Kindlundh et al., 1999; Wichstrøm and Pedersen, 2001). AAS seem indeed to serve as a gateway to the abuse of psychoactive drugs including opioids (Thiblin et al., 2000; Kanayama et al., 2003; Arvary and Pope, 2000) and show a particularly strong association with opioid dependence (Kanayama et al., 2009a,b). The use of narcotic agents may in turn remove barriers and increase the risk of proceeding to AAS use. Other substances commonly used together with AAS include legal performance-enhancing dietary supplements (Tonya et al., 2006).

The aim of this study is to investigate and describe the co-use of AAS and narcotic abuse among adolescents within the Swedish criminal justice system (Dunn et al., 2009).

2. Subjects and methods

Information about subjects' present and past drug use was obtained through mandatory interviews with individuals ($n=56$) suspected of infringement of the narcotic laws in Sweden and who either had AAS in their possession or had confirmed use of AAS. Data were collected between May 2007 and May 2008. The compulsory data collection was done by two police units in Stockholm: the

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Juvenile Drug Unit of the Stockholm County Police who work with abusers of narcotics >25 years of age, and the “Club Commission” of the Stockholm County Police who work with crimes connected to night clubs and restaurants. Both units are staffed by members of the narcotic police. Data was documented through an anonymous questionnaire. Data consisted of information about age, sex, confiscated AAS substances (type and amount), reasons for AAS abuse, experience of AAS use and regular gym training. Information gathered also included age at first and second use of AAS or narcotic agents (opioids, cocaine, amphetamine, cannabis, and marijuana) as well as information about ingestion of other medicines such as growth hormone, insulin, antiestrogens, hCG, clenbuterol, epedra, sildenafil and benzodiazepines. All subjects were also tested for AAS through analyses at the Doping Laboratory at our department. Only subjects testing positive for AAS were included for data registration and evaluation. For subjects testing negative for AAS only information about confiscated abuse agents and age was documented.

2.1. Statistical analysis

Descriptive statistics such as percentage, mean, range and standard error of the mean were used. Confidence intervals on proportions and the differences between proportions were also calculated. Data analyses were performed using MedCalc for Windows, version v9.5.2.0 (MedCalc Software, Mariakerke, Belgium) whenever applicable.

2.2. Ethical considerations

This study was approved by the Ethics Committee at Karolinska Institutet, Stockholm (registration number 2009/5:6).

3. Results

Eighty one percent ($n = 45$) of the subjects were confirmed users who tested positive for AAS; the remaining 19% ($n = 11$) only had substances in their possession. The mean age (SD) of the 45 subjects with confirmed AAS use was 30 ± 7.4 and 25 ± 4.2 for those with only possession.

A majority of the AAS users (73%, $n = 33$) also used narcotic agents. The mean age (SD) of this group was 27 ± 6.6 and age at first use of AAS was 24 ± 6.7 . Only a minority (21%), of these individuals started their drug use with AAS and 55% with narcotic agents. Data about the first-used substance was missing for 24% of subjects.

Twenty seven percent ($n = 12$) abused only AAS and the mean age (SD) in this group was 31 ± 9.5 , and age of first use was 28 ± 4.7 . Thirty six percent of those using only AAS and 56% of those with a dual use of narcotic agents and AAS did not perform muscle enhancing training.

The most commonly co-used substances were cannabis (35%), cocaine (28%), diazepam (26%), amphetamine (15%), ephedrine (11%), sildenafil (8%), heroin (4%) and other medicines (28%) such as: growth hormone, insulin, antiestrogens, hCG, clenbuterol, epedra, sildenafil and benzodiazepines.

The total amount of confiscated AAS was 181.7 g, of which only 6.0 g belonged to individuals who did not themselves test positive for AAS. The most commonly confiscated AAS were testosterone (100 g), nandrolone (25 g), trenbolone (18.4 g), boldenone (10.4 g), stanozolol (10.3 g), oxymetholone (8.8 g), methandienone (5.0 g) and methenolone (3.8 g).

4. Discussion

Our study has revealed extensive co-use of AAS and narcotic agents and other substances, particularly cannabis. The high pres-

ence of cannabis is probably due to the fact it is the most common drug at onset of use of narcotics and therefore also most commonly mixed with other drugs. Although the reliability of screening for AAS by interview, particularly by a police officer, can be called into question, we have overcome this problem by doing AAS analyses of the 56 subjects of this study.

Although this study confirms a suspected pattern of common co-use of AAS and narcotic agents, it cannot reveal to what extent AAS abuse exists among users of narcotic agents. Due to the fact that police officers collecting compulsory data mainly work with offenders of the Swedish narcotics law, the findings of AAS use are co-incidental. The indication for suspecting AAS use is possession, since all subjects positive testing for AAS had substances on their person that were confiscated by the police. Subjects who tested negative for AAS, but who had AAS substances in their possession, were probably not regular users of AAS and not traffickers given the small amount of AAS substances confiscated in this group.

Among individuals in the study who co-used AAS and narcotics, only 21% started with AAS. This indicates that use of AAS may be part of a general pattern of using drugs for recreational purposes, thus weakening the hypothesis that AAS use is primarily part of a “healthy lifestyle” pattern that includes body-building and use of nutritional supplements. Although our study was not designed to investigate the order of use in the career, it does not support the hypothesis that AAS is a gateway substance to use of narcotics.

A common view among researchers of AAS is that its use is mainly associated with heavy gym training. Yet surprisingly in this group of individuals, only a small fraction of dual users were gym customers. This was true even for those study subjects who only used AAS and no other narcotics. Since supraphysiologic doses of AAS may increase fat-free mass and muscle size even without strength training (Bhasin et al., 1996), it may appeal to some potential users who are uninterested in training but want to become stronger for aesthetic or other reasons. AAS are also known to increase aggressiveness and inhibit impulse control, and this may make them desirable among users who intend to commit criminal acts.

Supporting findings from a few previous studies, our study found that AAS use was part of a pattern of a multi-drug use for a significant percentage of men arrested by the police for infringement of narcotic laws in Sweden. This finding supports the findings of at least two previous studies, including one in which the use of psychotropic substances among Swedish high school students was highly associated with AAS use (Kindlundh et al., 1999), and one which found that 13% of opioid users at an in-patient treatment unit had also used AAS at some point in their lives (Kanayama et al., 2003).

Our study established that AAS use can be part of an advanced abuse pattern. AAS has been described as a gateway substance to opioid use by Kanayama et al. (2003), who found a 13% lifetime prevalence of AAS use among opioid-dependent inpatients in an abuse treatment unit and who describe a “gateway process” that starts with AAS and ends with opioid abuse. A possible basis for this association could be that AAS and opioids stimulate the same reward pathway in the brain. One problem with retrospective “gateway” studies among advanced abusers of narcotics is the choice of study population. Abusers of illegal drugs have almost always started their career with drugs other than for the present study drug. In our study opioids were only rarely used in combination with AAS. Cocaine seemed to be the preferred drug of use. A possible explanation for this is different study populations. Use of opioids is certainly more common among inpatients at abuse treatment unit compared to our study population. Kanayama et al. (2003) hypothesize that initial use of AAS readily paves the way to use of opioids (and other psychotropic substances) in the “gateway process.”

In our study, opioids were rarely used and cocaine was instead the drug of choice, but this is probably explained by the different study populations: opioids are more common among in-patients in treatment units than in the population in this study. In any case, a limitation of retrospective studies seeking to understand gateway processes among advanced narcotic users is that almost all such users have started their careers with other drugs. It is difficult to pinpoint which drug was the gateway drug. Furthermore, the numbers of individuals who may have used certain drugs but not gone on to further use are not uncovered by such studies.

Two areas of further research are suggested by this study. One is on the neurobiochemistry of AAS and other drug use. A possible physical basis for the co-administration of AAS and opioids found in [Kanayama et al.'s study \(2003\)](#) is that AAS and opioids stimulate the same reward pathway in the brain. Another type of physical process that seems to encourage co-administration of drugs relates to the side effects AAS causes, which increase the likelihood of use of aromatase inhibitors, hCG and other hormonal pharmaceuticals to counteract or overcome these side effects. More studies of the interaction of AAS and other drugs could help us understand the physical effects that make AAS so appealing to users despite their many side effects, as well as why co-administration of AAS and other psychotropic substances seems to occur in some populations.

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Conflict of interest

No conflict was declared.

Contributors

Gårevik performed the initial design of the study, which was subsequently slightly amended by Rane. RN Gårevik performed the literature search, the data analysis and wrote the first draft of the manuscript. Both authors contributed to successive revisions of the manuscript and have approved the final manuscript.

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References

- Arvary, D., Pope Jr., H.G., 2000. Anabolic-androgenic steroids as a gateway to opioid dependence. *N. Engl. J. Med.* 342, 1532.
- Bhasin, S., Storer, T.W., Berman, N., Callegari, C., Clevenger, B., Phillips, J., Bunnell, T.J., Tricker, R., Shirazi, A., Casaburi, R., 1996. The effects of supraphysiologic doses of testosterone on muscle size and strength in normal men. *N. Engl. J. Med.* 335 (July (1)), 1–7.
- Brower, K.J., Blow, F.C., Eliopoulos, G.A., Beresford, T.P., 1989. Anabolic androgenic steroids and suicide. *Am. J. Psychiatry* 146, 1075.
- Brower, K.J., 2002. Anabolic steroid abuse and dependence. *Curr. Psychiatry Rep.*, 377–387.
- Conacher, G.N., Workman, D.G., 1989. Violent crime possibly associated with anabolic steroid use. *Am. J. Psychiatry* 146, 679.
- Dunn, M., Mazanov, J., Sitharthan, G., 2009. Predicting future anabolic-androgenic steroid use intentions with current substance use: findings from an internet-based survey. *Clin. J. Sport Med.* 19 (May (3)), 222–227.
- Fingerhood, M.I., Sullivan, J.T., Testa, M., Jasinski, D.R., 1997. Abuse of liability of testosterone. *J. Psychopharmacol.* 11, 59–63.
- Hall, R.C., 2005. Abuse of supraphysiologic doses of anabolic steroids. *South Med. J.* 98, 550–555.
- Kanayama, G., Hudson, J.I., Pope Jr., H.G., 2009a. Illicit anabolic-androgenic steroid use. *Horm. Behav.* (September) (Epub ahead of print).
- Kanayama, G., Cohane, G.H., Weiss, R.D., Pope, H.G., 2003. Past anabolic-androgenic steroid use among men admitted for substance abuse treatment: an under recognized problem? *J. Clin. Psychiatry* 64, 156–160.
- Kanayama, G., Hudson, J.I., Pope Jr., H.G., 2009b. Features of men with anabolic-androgenic steroid dependence: a comparison with nondependent AAS users and with AAS nonusers. *Drug Alcohol Depend.* 102 (June (1–3)), 130–137.
- Kindlundh, A.M., Isacson, D.G., Berglund, L., Nyberg, F., 1999. Factors associated with adolescent use of doping agents: anabolic-androgenic steroids. *Addiction* 94, 543–553.
- Nilsson, S., Baigi, A., Marklund, B., Fridlund, B., 2001. The prevalence of the use of androgenic anabolic steroids by adolescents in a county of Sweden. *Eur. J.* 195–197.
- Pallesen, S., Jøsendal, O., Johnsen, B.H., Larsen, S., Molde, H., 2006. Anabolic steroid use in high school students. *Subst. Use Misuse* 4, 1705–1717.
- Pope Jr., H.G., Katz, D.L., 1987. Bodybuilder's psychosis. *Lancet* 11, 863.
- Pope Jr., H.G., Katz, D.L., 1988. Affective and psychotic symptoms associated with anabolic steroid use. *Am. J. Psychiatry* 145, 487–490.
- Rachoń, D., Pokrywka, L., Suchecka-Rachoń, K., 2006. Prevalence and risk factors of anabolic-androgenic steroids (AAS) abuse among adolescents and young adults in Poland. *Soz. Praventivmed.* 51, 392–398.
- Tahtamouni, L.H., Mustafa, N.H., Alfaouri, A.A., Hassan, I.M., Abdalla, M.Y., Yasin, S.R., 2008. Prevalence and risk factors for anabolic-androgenic steroid abuse among Jordanian collegiate students and athletes. *Eur. J. Public Health*, 4.
- Takahashi, M., Tatsugi, T., Kohno, Y., 2007. Telephone counseling of athletes abusing anabolic-androgenic steroids. *J. Sports Med. Phys. Fitness* 47, 356–360.
- Thiblin, I., Lindquist, O., Rajs, J., 2000. Cause and manner of death among users of anabolic androgenic steroids. *J. Forensic Sci.* 45, 16–23.
- Dodge, T.L., Jaccard, J.J., 2006. The effect of high school sports participation on the use of performance-enhancing substances in young adulthood. *J. Adolesc. Health* 39, 367–373.
- Wanjek, B., Rosendahl, J., Strauss, B., Gabriel, H.H., 2007. Doping, drugs and drug abuse among adolescents in the State of Thuringia (Germany): prevalence, knowledge and attitudes. *Int. J. Sports Med.* 28, 346–353.
- Wichstrøm, L., Pedersen, W., 2001. Use of anabolic-androgenic steroids in adolescence: winning, looking good or being bad? *J. Stud. Alcohol.* 62, 5–13.
- Wood, R.I., 2004. Reinforcing aspects of androgens. *Physiol. Behav.* 83 (November (2)), 279–289, Review.