

Selling androgenic anabolic steroids by the pound: identification and analysis of popular websites on the Internet

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Internet websites offering androgenic anabolic steroids (AAS) were identified and available products were examined. Keywords for the website search were: “anabolic steroids,” “anabolic steroids buy,” “anabolic steroid purchase.” The first 10 websites offering AAS in the first 10 pages of results were considered. At least two AAS-containing products per website were selected. Thirty AAS-selling websites were identified, mainly located in the United States (46.7%) and Europe (30%). Most websites sold other anabolic/ergogenic products (clenbuterol, 76.7%; GH/IGF, 60.0%; thyroid hormones, 46.7%; erythropoietin, 30.0%; insulin, 20.0%) or products for AAS-related adverse effects (mainly: estrogen antagonists, 63.3%; products for erectile dysfunction, 56.7%; 5 α -reductase inhibitors, 33.3%; anti-acne products, 33.3%). AAS were sold as

medicines (69.6%) or as dietary supplements (30.4%). AAS in medicines were mainly: nandronole (20.4%), methandrostenolone (18.4%), and testosterone (12.2%). Dietary supplements contained mainly DHEA and included several fake compounds. Manufacturers were declared for 97.9% of medicines and 66.7% of dietary supplements; however, several manufacturers were not found on the Internet. Described benefits were usually few adverse effects and no estrogenicity. Toxicity was seldom reported and presented as mild. Recommended doses were two–fourfold higher than current medical recommendations. In conclusion, misleading information and deceiving practices were common findings on AAS-selling websites, indicating their deleterious potential for public health.

Androgenic anabolic steroids (AAS) were identified in the early 1930s; however, the use of extracts from rodent or dog testes endowed with “puissance dynamogénique,” according to Brown-Séguard’s definition, was already popular at the end of 18th century, in the context of “organotherapy” (Sneider, 2005). AAS mimic the effects of the male gonadal steroids testosterone and dihydrotestosterone, resulting in increased muscle growth and strength. As a consequence, athletes have been using and abusing AAS for decades, a fraudulent practice banned since 1975 by the International Olympic Committee and subsequently by all major athletic organizations and sporting bodies (Verroken & Mottram, 2005).

Several therapeutic drugs containing AAS are available for the treatment of cachexia associated with chronic disease as well as for loss of muscle mass in the elderly; however, their effects on physical function and quality of life are still debated (Kicman, 2008). On the other side, in sport AAS are well-known performance enhancers, and their use occurs at suprathreshold doses, often taking illicit preparations from the black market, thus leading to an increased risk of serious adverse effects. AAS-in-

duced adverse effects target several organs and tissues, including the cardiovascular system, the liver, the reproductive system, the bones, breast and hair, skin and vocal cords, and even the central nervous system. In particular, the central effects of AAS include: increased libido in men and women, which may be difficult to control, hypomania, heightened irritability, increased aggression and hostility, destructive and self-destructive impulses (Kicman, 2008). Recently, AAS dependence has been proposed as a valid diagnostic entity, and probably a growing public health problem (Brower, 2009; Kanayama et al., 2009). Indeed, awareness of the risks associated with AAS abuse led several countries to introduce controls on their use and prescription: in the United Kingdom, AAS are controlled by the Misuse of Drugs Act (Royal Pharmaceutical Society of Great Britain, 2010), in Canada they are included in the Controlled Drugs and Substances Act (Minister of Justice of Canada, 2010), while the Congress of the United States passed the Anabolic Steroid Control Act in 1990 (updated in 2004) and AAS were soon classified as Schedule III substances under the Controlled Substances Act (U.S. Department of Justice,

2005). In Italy, as in many other countries, it is illegal to obtain or sell them without a prescription, and recently nandrolone has been included in the list of controlled substances in view of its addictive potential (Minister of Health of Italy, 2010).

A major reason for concern is that most AAS users are not competitive athletes at all, but simply individuals troubled with their “body image” (Buckley et al., 1988; Kanayama et al., 2001). Such kind of “ordinary” AAS users rarely seek treatment and often distrust and escape physicians, while commonly abusing of two or more AAS and often taking huge doses for prolonged periods (reviewed by Kanayama et al., 2008). The medical and psychiatric consequences of AAS abuse however usually occur after long-term use at supraphysiologic doses, therefore, because widespread use of AAS began to emerge only in about 1980, it is likely that the social consequences will become increasingly evident in the next few years, when hundreds of thousands of AAS users begin to pass the age of 45 (Kanayama et al., 2008). Prevention of AAS misuse is therefore of key importance and should include, besides random doping analyses, longer disqualifications of AAS-using athletes, and tougher legislation against possession of AAS, also medical and pedagogic interventions, particularly targeted to adolescents and other more vulnerable subjects (Sjöqvist et al., 2008; Greydanus & Patel, 2010). To this end, however, physicians and educators must be aware of the attitudes and beliefs of AAS users, which preferentially derive from consultation of friends, of people who sold them AAS, or even in particular in recent times, specialized Internet sites (Pope et al., 2004).

Indeed, despite the increasing regulation, available evidence indicates that the world traffic of doping substances and in particular of AAS is sharply increasing, in particular through the Internet (Donati, 2007). Among the various pathways sought by drug traffic, the Internet is probably the main worldwide channel for easy access to drugs and other substances. According to a report focused on pain relievers, anxiolytics, and stimulants, 85% of websites selling controlled drugs did not require buyers to have a prescription (The National Center on Addiction and Substance Abuse at Columbia University, 2008). Although recently it has been suggested that the Internet is still a relatively minor source for illicit purchases of prescription medications by the individual end-users of these drugs (Inciardi et al., 2010), a survey in 1955 US-based male non-medical AAS users showed that more than half of the sample had purchased AAS over the Internet (Cohen et al., 2007), and in another survey, posted on the message boards of Internet websites popular among AAS users, >70% of the respondents indicated Internet as their drug source

(Parkinson & Evans, 2006). Circumstantial evidence indeed suggests that Internet is possibly the primary means for buying and selling illicit AAS (Government Accountability Office, 2005) and a primary source of non-medical AAS information (Perry et al., 2005).

The present study was therefore devised to identify a representative sample of websites offering AAS on the Internet and to evaluate their characteristics with particular regard to the types of products available and the kind of information provided. A sample of products was also selected and the related claims were carefully scrutinized.

Methods

Internet search

The search was conducted by one of us (F. G. C.), who acted as a consumer and attempted to purchase AAS on the Internet. The search was performed by use of a personal computer connected to Internet via ADSL, from August 9 to September 29, 2009, using Mozilla Firefox ver. 3.0.15 as Internet browser. Google was selected as the search engine because it accounts for about 65% of Internet searches in the world (Search Engine Watch Staff, 2009) and for up to 88% in Italy (Bonfils, 2010). The keywords used were “anabolic steroids,” “anabolic steroids buy,” “anabolic steroid purchase,” and the search was performed in English and in Italian.

Websites

For each combination of keywords, we identified the first 10 websites that offered AAS (or products presented as such) in the first 10 pages of results. We then recorded for each website the universal resource locator and the position in the list of Google results. Additional information about the websites (IP locations and addresses, names of domains, registration/creation/expiration/last update date of domains, registrants/administrators of websites) was subsequently obtained by the use of WhoIs Source (whois.domaintools.com). Website analysis included: website language(s), sold products, drug prescription requirements, need for creation of a personal account and subsequent login, indication of a minimum/maximum amount of products that could be bought, payment options, and shipment methods. Finally, an image of the website homepage was obtained and the date and hour of the last access to the website were registered.

Medicines and other products

At least two AAS-containing products were identified for each website. Selection was made on the basis of the position, presentation, and emphasis posed on the products in the websites homepage. Products were classified as either medicines or dietary supplements, according to the presentation in the website.

For each product, we recorded: product name and composition, declared manufacturer, price, claimed properties, proposed benefits and advantages, therapeutic uses, recommended doses and duration of treatment, suggestions for combined use of other products, and declared side effects. An image of the product was also obtained.

Declared AAS molecules were searched for on web-based databases for chemical compounds [PubChem (pubchem.ncbi.nlm.nih.gov); reaxis (http://www.reaxys.com), SciFinder (scifinder.cas.org)] as well as on websites such as PubMed (http://www.ncbi.nlm.nih.gov/sites/pubmed) and Wikipedia (en.wikipedia.org). In some cases, free searches were also performed on specialized websites and forums dedicated to bodybuilders.

Statistics

The data were summarized using descriptive statistics.

Results

Websites

We identified 30 different websites (Table 1). Most of them ($n = 19$, 63.3%) sold only AAS-containing products presented as medicines, while the remaining (10, 33.3%) sold only dietary supplements, and only one website sold products presented as either medicines or dietary supplements. Nearly half of the websites (14, 46.7%) were located in the United States, while the remaining websites were hosted in various states in Europe (9, 30%), in Canada (2,

6.7%), in the Republic of Panama (2, 6.7%), and in Hong Kong (1), Malaysia (1) and Turkey (1).

All the websites were in English, with the exception of one (website no. 1), which was located in the United States but was completely in Italian. Only six websites (20%) proposed two or more different languages (website no. 30, however, proposed up to 12 different languages).

Five of the selected websites (nos. 12, 17, 18, 20, 23) revealed an extremely high degree of similarity with regard to appearance of the homepage, site organization, sold products, purchase conditions, and registrants' data, therefore clearly resembling copy sites.

Each website selling AAS-containing medicines offered on average 52.4 products (minimum: five; maximum: 152), while each website selling dietary supplements offered on average nine products (minimum: one; maximum: 34). The only website selling both medicines and dietary supplements offered 36 products.

Besides AAS, most of the websites sold other products, either anabolic/ergogenic or intended for the treatment of AAS-related adverse effects. Available anabolic/ergogenic products were: clenbuterol

Table 1. Websites evaluated for AAS purchase

No.	Website name	URL	Website location	Language
1	American Lifestyle	http://www.bellezzaedieta.com	USA – Colorado	I
2	Anabolic Steroid Central	http://www.anabolicsteroidscentral.com	Malaysia	E, G, F
3	Anabolic Steroid Store	http://www.anabolicsteroidstore.com	USA – Ohio	E
4	Anabolic Steroids	http://www.anabolicsteroids.com	USA – Oregon	E
5	AnabolicWeb	http://www.anabolicweb.com	Republic of Panama	E
6	AnaboliczStore	http://www.anaboliczstore.com	Hong Kong	E
7	AnaboliczWorld	http://www.anaboliczworld.com	Turkey	E
8	Bulking-Cutting	http://www.bulking-cutting.com	USA – Colorado	E
9	Buy-Anabolic-Steroids	http://www.buy-anabolic-steroids.com	USA – Illinois	E
10	Buysterooids	http://www.buysterooids.com	USA – New Jersey	E
11	Eurobolic	http://www.eurobolic.com	Republic of Lithuania	E, G, S, I, F
12	FitnessMed	http://www.fitnessmed.net	Republic of Moldova	E
13	GP Roids	http://www.gproids.com	USA – Illinois	E
14	IBuy Steroids	http://www.ibuysterooids.com	Canada – British Columbia	E
15	Juice RX	http://www.juicex.com	USA – Arizona	E
16	Legal Steroids	http://www.legasteroids.com	USA – Virginia	E
17	Med4Sale	http://www.med4sale.net	England	E
18	MedOutlet	http://www.medoutlet.net	Republic of Moldova	E
19	Megabolix	http://www.megabolix.com	USA – Texas	E
20	NewSteroid	http://www.newsteroid.com	Russian Federation	E
21	Online Legal Steroids	http://www.onlinelegalsteroids.com	USA – Arizona	E
22	Pharmaeurope	http://www.pharmaeurope.com	Republic of Panama	E
23	PharmaSport	http://www.pharmasport.org	Republic of Moldova	E
24	Roid 4U	http://www.roid4u.com	Czech Republic	E, I, F, G, Fi, D
25	Roid-Shop	http://www.roid-shop.com	Canada – British Columbia	E
26	Steroid 1	http://www.steroid1.com	USA – Illinois	E, F
27	Steroids Shop	http://www.steroidshop.net	USA – Bahamas	E, I, S, F, G, P
28	Steroids4u	http://www.steroids4u.net	Czech Republic	E
29	The Roid Store	http://www.roidstore.com	USA – New Jersey	E
30	Vitanatural.eu	http://www.vitanatural.net	Germany	E, G, S, F, I, Sw, P, D, Po, Fi, Da, No

Sites are listed in alphabetical order, according to the website name.

D, Dutch; Da, Danish; E, English; F, French; Fi, Finnish; G, German; I, Italian; No, Norwegian; P, Portugese; Po, Polish; S, Spanish; Sw, Swedish; AAS, androgenic anabolic steroids.

(23 websites, 76.7% of total websites), GH/IGF (18, 60.0%), thyroid hormones (14, 46.7%), erythropoietin (nine, 30.0%), and insulin (six, 20.0%). Products for the treatment of AAS-related adverse effects were estrogen antagonists (19, 63.3%), products for erectile dysfunction (17, 56.7%), 5 α -reductase inhibitors (10, 33.3%), anti-acne products (10, 33.3%), hepatoprotectors (seven, 23.3%), human chorionic gonadotropin (six, 20.0%), “treatments for psychological disturbances” (four, 13.3%), cardiovascular drugs (three, 10.0%), anti-diabetic agents (three, 10.0%), antidyslipidemic drugs (two, 6.7%), and “cancer treatment” (one, 3.3%).

Thirteen websites (43.3%) also proposed “steroid cycles” or “stacks” (i.e. ready-made associations of AAS with allegedly different androgenic:anabolic ratios, a common practice among AAS users, which is believed to minimize side effects while increasing efficacy). In eight cases, stacks were sold together with diuretics (spironolactone).

Purchase and payment

In all of the selected websites, no prescription was required for the purchase of AAS-containing products presented as medicines. In two cases (websites nos. 2 and 11), voluntary presentation of a prescription was however the precondition to grant product delivery. Most of the websites (19, 63.3%) required the creation of a personal account to access products, while the remaining websites required personal data only during order placement. Only a minority of the websites (seven, 23.3%) indicated minimum/maximum purchase requirements, which were usually between US\$100 and US\$250 (minimum) and US\$500–US\$2500 (maximum). Interestingly, in two websites (nos. 9 and 26) the minimum requirement increased from US\$250 to US\$500 for delivery addresses with military zip codes of the APO/AE type.

Payment options included credit card (always VISA and/or MasterCard circuits) and money transfer (Western Union or MoneyGram). With money transfer, the payee’s name was indicated only after order placement and payment (with the only exception of website no. 7, where information about payee’s name was provided in advance).

Postal delivery was the shipment method used by all the websites examined. Only a few websites, however, clearly specified the kind of postal delivery (e.g., by airmail, USPS, DHL or other), and in only two cases the type of delivery could be selected by the purchaser. Website no. 2 explicitly accepted delivery to PO boxes only upon payment by money transfer. Several websites reassured about the parcel being completely anonymous and as small as possible. Dividing the order in distinct postal packages was usually mentioned as an effective means to reduce

individual package size, thus avoiding custom inspections. Website no. 26 declared that the parcel would have been labeled as a “gift,” while website no. 9 excluded shipments toward Brazil, China or France. Custom inspections and the subsequent product seizure/confiscation was mentioned as a possible occurrence by most of the websites; however, further shipment was granted only by website no. 29, while refunding was considered only by websites nos. 2, 6, 9, and 26 and in any case only upon presentation of “proof of product confiscation” from the purchaser.

Analysis of selected products

We selected a total of 69 AAS-containing products, 48 (69.6% of total) sold as medicines (Table 2) and the remaining 21 (30.4%) sold as dietary supplements (Table 3).

Composition

AAS in products sold as medicines were always declared, and were: nandronole (10 products, 20.4% of total products; in nine cases decanoate and in one phenylpropionate), methandrostenolone (nine, 18.4%), testosterone (six, 12.2%; in two cases undecanoate, in two cases as a mix of propionate, phenylpropionate, caproate, isocaproate, and in one, respectively, enanthate or propionate), oxandrolone (five, 10.2%), methenolone enantate (four, 8.2%), stanozolol (four, 8.2%), boldenone undecylenate (three, 6.1%), dromostanolone dipropionate (two, 4.1%), methyltestosterone (two, 4.1%), oxymetholone (two, 4.1%), fluoxymesterone, nandrolone phenylpropionate, and trenbolone acetate (one each). All the declared AAS corresponded to existing molecules.

AAS in products sold as dietary supplements were declared in only 12 out of 21 products (57.1%) and included: DHEA (four products, in three cases in association with other AAS, in two cases as an association of different DHEA salts, and in one case indicated in the same product as both 3 β -hydroxy-5-androsten-17-one and as androstenolone, equivocally suggesting the presence of two distinct compounds), 7-keto-DHEA (1), dicyclopentanone (1), and estra-4,9-diene-3,17-dione (1). Other declared AAS included: 25R spirostan-5A-diol-6-one-3-one (three products, always in association with DHEA), methandrostenol (2), cyclostanazol (2), 3-undecanodrol (1), prasterone (1), nandecionate (1), and oxantrione (1). None of these compounds could be identified as existing molecules, with the partial exception of 25R spirostan-5A-diol-6-one-3-one, which might stand for 5- α , 25R 5-hydroxy-spirostan-3,6-dione (Dawidar et al., 1980), and of praster-

Table 2. Main AAS sold on selected websites as medicines

No.	Declared AAS	Brand name	Website	Administration route	Declared manufacturer	Price (Euro)	Price/100 mg AAS (Euro)
1	Boldenone undecylenate	Boldabol 200	anabolicweb.com	i.m.	British Dragon	97.12	4.85
2	Boldenone undecylenate	Boldabolic	eurobolic.com	i.m.	Asia Pharma	139.00	6.95
3	Boldenone undecylenate	Boldoject 200	steroids4u.com	i.m.	Eurochem Laboratories	88.00	4.40
4	Dromostanone dipropionate	Dromostan	anabolicweb.com	i.m.	Xelox Pharma	85.91	17.18
5	Dromostanone dipropionate	Methandriol Dipropionate 75	buy-anabolic-steroids.com	i.m.	British Dragon	136.00	18.10
6	Fluoxymesterone	Halotest M60	newsteroid.com	os	Balkan Pharmaceuticals	209.18	34.86
7	Methandrostenolone	Anabol	anabolicsteroidcentral.com	os	British Dispensary	64.00	12.80
8	Methandrostenolone	Anabol 10	anabolicstore.com	os	British Dispensary	35.86	7.17
9	Methandrostenolone	Anabol Tablets	steroid1.com	os	British Dispensary	70.97	1.90
10	Methandrostenolone	Danabol DS	megabolix.com	os	Body Research	121.21	2.42
11	methandrostenolone	D-Bolic	ibuysteroids.com	os	British Dragon Gear Ltd.	64.99	NA
12	Methandrostenolone	Methanabolic	eurobolic.com	os	Asia Pharma	89.00	8.90
13	Methandrostenolone	Methandienone Tablets IP	steroidshop.net	os	Genesis Labs	45.00	4.50
14	Methandrostenolone	Naposim	anaboliczworld.com	os	Terapia Ranbaxy	29.88	5.97
15	Methenolone enantate	Primobolan Depot	eurobolic.com	i.m.	Schering	15.00	15.00
16	Methenolone enantate	Primobolan Depot	newsteroid.com	i.m.	Schering	119.53	11.95
17	Methenolone enantate	Primobolan Depot	steroidshop.net	i.m.	Schering	17.00	17.00
18	Methenolone enantate	Primobolic	pharmaeurope.com	i.m.	Asia Pharma	159.00	15.90
19	Methyltestosterone	Methyltestosterone	steroids4u.net	os	ND	11.00	1.10
20	Methyltestosterone	Turanabol Tablets	roid4u.com	os	British Dragon Pharmaceuticals	115.00	5.75
21	Nandrolone decanoate	Deca 200	anaboliczstore.com	i.m.	GEN-SHI Laboratories	12.70	6.35
23	Nandrolone decanoate	Deca Durabolin	anabolicsteroidcentral.com	i.m.	Norma Hellas	19.00	9.50
24	Nandrolone decanoate	Deca Durabolin	anaboliczworld.com	i.m.	Generics Pharm	11.20	5.60
25	Nandrolone decanoate	Deca Durabolin	pharmaeurope.com	i.m.	Organon	17.00	8.50
26	Nandrolone decanoate	Deca Durabolin	steroid1.com	i.m.	Organon	3.73	NA
27	Nandrolone decanoate	Decabolin Depot 100	newsteroid.com	i.m.	LYKA Pharmaceutical Company	44.07	4.40
28	Nandrolone decanoate	Decca 250	ibuysteroids.com	os	British Dragon Gear Ltd.	73.20	NA
29	Nandrolone decanoate	Nandrolone Decanoate Injection Bp	megabolix.com	i.m.	Genesis	75.31	6.02
30	Nandrolone decanoate	Nandrolone Decanoate	steroidshop.net	i.m.	Norma Hellas	16.00	8.00
31	Oxandrolone	Duraject	buy-anabolic-steroids.com	i.m.	Eurochem Laboratories	80.00	NA
32	Oxandrolone	AnVar 10	ibuysteroids.com	os	British Dragon Gear Ltd.	65.73	NA
33	Oxandrolone	Bonavar	anabolicsteroidstore.com	os	Body Research	50.80	40.64
34	Oxandrolone	Bonavar	roid4u.com	os	Body Research	69.00	55.20
35	Oxandrolone	Oxanabol Tablets	buy-anabolic-steroids.com	os	British Dragon	135.00	27.00
36	Oxymetholone	Oxandrolone LA	megabolix.com	os	LA Pharma	95.71	38.28
37	Oxymetholone	Anapolon	pharmaeurope.com	os	Abdi Ibrahim	59.00	5.90
38	Stanozolol	Hemogenin	anabolicweb.com	os	Sanofi Aventis	32.12	6.42
39	Stanozolol	Winstrol Depot	anabolicsteroidcentral.com	i.m.	Zambon	21.00	42.00
40	Stanozolol	Winstrol Depot	anaboliczstore.com	i.m.	Zambon	12.70	25.40
41	Stanozolol	Winstrol Depot	steroid1.com	i.m.	Zambon	35.86	NA
42	Testosterone (propionate, phenylpropionate, caproate, isocaproate)	Winstrol Tablets	anaboliczworld.com	os	Zambon	17.93	44.80
		Omnadren	steroids4u.net	i.m.	Jelifa	9.00	NA

Table 2. (continued)

No.	Declared AAS	Brand name	Website	Administration route	Declared manufacturer	Price (Euro)	Price/100 mg AAS (Euro)
43	Testosterone (propionate, phenylpropionate, caproate, isocaproate)	Sustanon 250	gproids.com	i.m.	Organon	7.00	NA
44	Testosterone enanthate	Testosterone Enanthate 250	roid4u.com	i.m.	Aburaihan Co.	3.00	1.20
45	Testosterone propionate	Testolic	gproids.com	i.m.	Body Research	45.00	2.25
46	Testosterone undecanoate	Andriol	anabolicsteroidstore.com	os	Organon	53.79	2.23
47	Testosterone undecanoate	Andriol	gproids.com	os	Organon	50.00	2.08
48	Trenbolone acetate	Tren 100	anabolicsteroidstore.com	i.m.	Globalanabolic Company Ltd.	89.65	8.96

Products are listed in alphabetical order, according to declared AAS.

ND, not declared; NA, not available (no information about AAS amount); AAS, androgenic anabolic steroids.

one, which might indicate the proprietary name of a DHEA-containing product (Kocis, 2006). Methandrostrenol might stand for methandrostrenolone; however, the content declared (230 mg/capsule) would be exceedingly high for this compound.

No information regarding excipients was usually given either for medicines or for dietary supplements.

Manufacturer

The manufacturers were declared in all but one case (97.9%) for AAS-containing products sold as medicines (Table 2), however, in only 14 cases (66.7%) for products sold as dietary supplements (Table 3). Declared manufacturers of medicines were a total of 21; however, those producing three or more of the selected products were: British Dragon (also mentioned as British Dragon Gear Ltd. or British Dragon Pharmaceuticals; seven products, 14.6% of total products), Organon (five, 10.4%), Body Research (four, 8.3%), Zambon (four, 8.3%), Asia Pharma (three, 6.2%), British Dispensary (three, 6.2%), and Schering (three, 6.2%). Declared manufacturers of dietary supplements were a total of five, namely: Oregon Labs (six products, 28.6% of total products), HI TECH Pharmaceuticals (three, 14.3%), SDI-Labs (three, 14.3%), AMS (one, 4.8%), and Natrol (one, 4.8%).

All the declared manufacturers of medicines appeared to have a dedicated website on the Internet (data not shown) with the notable exceptions of Body Research, Genesis Labs, and Xelox Pharma. Moreover, British Dispensary (<http://www.britishdispensary.com>) does not appear to produce AAS, according to information available on its website. Similarly, Lyka Pharmaceutical Company resembled Lyka Labs (<http://www.lykalabs.com>), a Mumbai (India)-based pharmaceutical company not involved in AAS production. Finally as of July 4, 2010, the few information available on the websites of LA Pharma ([laanabolic.com](http://www.laanabolic.com)) and of Globalanabolic Company Ltd. (<http://www.globalanabolics.com>) did not allow to identify the nature and activities of these two organizations.

As for dietary supplements, only four out of five declared manufacturers could be traced on the Internet, because the website of Oregon Labs could not be identified. Further uncertainty also remained for SDI-Labs, possibly corresponding to <http://www.sdi-labs.com>, which however (based on the website contents examined on July 4, 2010) resembles more a seller rather than a producer.

Prices

Product prices are shown in Tables 2 and 3. For products sold as medicines, which usually contained only one AAS, the price per 100 mg of active

Table 3. Main AAS sold on selected websites as dietary supplements

No.	Declared AAS	Brand name	Website	Admin. route	Declared manufacturer	Price (Euro)
1	3-undecanodrol*	Deca Nor 50	legalsteroids.com	os	SDI-Labs	59.86
2	Cyclostanazol*	Winni V	bellezzaedieta.com	os	NS	134.26
3	Cyclostanazol*	Winni V	legalsteroids.com	os	SDI-Labs	59.86
4	DHEA	DHEA	vitanatural.net	os	Natrol	34.50
5	DHEA (acetate, cypionate, propionate, enanthate); 25R spirostan-5A-diol-6-one-3-one [†]	Anavar	bellezzaedieta.com	os	HI TECH Pharmaceuticals	47.73
6	DHEA (acetate, decanoate); 7-keto-DHEA; 25R spirostan-5A-diol-6-one-3-one [†] ; dicyclopentanone	Dianabol	bellezzaedieta.com	os	HI TECH Pharmaceuticals	49.22
7	DHEA; 25R spirostan-5A-diol-6-one-3-one [†] ; prasterone*	Sustanon 250	vitanatural.net	os	HI TECH Pharmaceuticals	49.50
8	Estra-4.9-diene-3.17-dione	Dienedrone	vitanatural.net	os	AMS	45.00
9	Methandrostenol*	D-anabol 25	roidstore.com	os	NS	63.64
10	methandrostenol*	D-Bol	legalsteroids.com	os	SDI-Labs	59.86
11	nandecionate*	Deca 200	roidstore.com	os	NS.	74.88
12	oxantrione*	Var 10	roidstore.com	os	NS	63.64
13	NS	D-Bol	juicerx.com	os	NS	49.97
14	NS	Deca 500	juicerx.com	os	NS	63.39
15	NS	Dura 50	bulking-cutting.com	os	Oregon Labs	51.66
16	NS	Primo Orals	bulking-cutting.com	os	Oregon Labs	51.66
17	NS	Thai 25	bulking-cutting.com	os	Oregon Labs	58.96
18	NS	Thai 25	onlinelegalsteroids.com	os	Oregon Labs	63.40
19	NS	Thai 50	onlinelegalsteroids.com	os	Oregon Labs	70.86
20	NS	Winn V	juicerx.com	os	NS	49.97
21	NS	Winstrol V	onlinelegalsteroids.com	os	Oregon Labs	55.94

Products are listed in alphabetical order, according to brand name.

*‘fake’ AAS, see also ‘Results.’

[†]Possibly indicates 5 α , 25R 5-hydroxy-spirostan-3,6-dione, see also ‘Results.’

NS, not specified; AAS, androgenic anabolic steroids.

compound could be easily estimated (with the only exceptions of products nos. 11, 22, 27, 30, 31, 40, 42, 43, where the amount of AAS was not clearly indicated). On the contrary, for dietary supplements the price per 100 mg of active compound could never be estimated due to lack of information about the amount (nine products, nos. 1–4 and 8–12) or even the type of AAS contained (nine products, nos. 13–21), or due to the declared presence of three or more AAS in the same products (three products, nos. 5–7).

Claimed properties

Expected benefits and advantages and possible therapeutic uses of AAS contained in products sold as medicines are summarized in Table 4 as presented in the various websites. Expected benefits were described for all the compounds, most frequently: low risk or mildness of adverse effects (five out of 14 compounds), no conversion to estrogens or even direct antiestrogenic effects (four compounds), wide use and popularity (three compounds). Therapeutic uses were described for only six compounds, were usually very imprecise and included unregistered or even unsubstantiated uses (e.g., the treatment of larynx cancer).

Table 4 also shows recommended doses, which were reported in nearly all the cases and were usually differentiated for females and males (with the exceptions of methyltestosterone, testosterone undecanoate, and trenbolone acetate). Testosterone esters for parenteral use were the only AAS explicitly contraindicated in females. Recommended doses were given also for boldenone undecilenate and trenbolone acetate, which are registered for veterinary use only. Interestingly, in some cases (oxymetholone and trenbolone acetate) recommended doses varied in relation to the ‘‘experience’’ of users. Treatment duration was never clearly defined (in only three cases, the need to refer to physician’s advice was mentioned), and information regarding correct administration by injection was never given, even if most of the products were sold for intramuscular use.

Adverse effects

AAS-related adverse effects were described in a minority of cases. Moreover, only a few of the potential effects were mentioned, namely: acne (in 26 out of 69 products, 37.1%), hydric retention (24, 34.3%), hair loss/baldness (18, 25.7%), hirsutism (17, 24.3%), gynecomastia (16, 22.8%), inhibition of endogenous production of testosterone (16, 22.8%),

Table 4. Overview of claimed properties, recommended doses and cost of AAS

AAS	Benefits and advantages	Therapeutic uses	Recommended doses
Boldenone undecilenate	Gradual effects; stimulates erythropoiesis; veterinary use	Weight gain promotion after surgery, after chronic infections, after traumas and in “inadequate” body weight	Females: 50–100 mg weekly Males: 400–600 mg weekly
Dromostanolone dipropionate	Antiandrogenic effects due to ER antagonism; no conversion by aromatase; recommended before bodybuilding competitions; synthetic derivative of DHT	ND	Females: 50–150 mg weekly Males: 400–600 mg weekly
Fluoxymesterone	Recommended as an alternative to methandienone; strength-building effects	ND	ND
Methandrostenolone	Causes positive nitrogen balance; recommended in “bulking” phase	Pain reduction in osteoporosis; treatment of larynx cancer through induction of increased sensitivity of tumor cells to radiotherapy; weight gain promotion after surgery or after intensive use of corticosteroids	Females: 5–10 mg weekly Males: 15–50 mg weekly
Methenolone enantate	Low risk of side effects; not converted to estrogens; recommended in women	Weight gain promotion after surgery, chronic infections, traumas and in “inadequate” body weight	Females: 50–100 mg weekly Males: 100–400 mg weekly
Methyltestosterone	One of oldest AAS; strength-building effects	ND	30–50 mg daily
Nandrolone decanoate	Large popularity; mild unwanted effects	Alleviation of joint-related pain; treatment of anemia	Females: 50–100 mg weekly Males: 200–800 mg weekly
Nandrolone phenylpropionate	Enters quickly the bloodstream	ND	150–600 mg weekly
Oxandrolone	Few adverse effects; recommended in “cutting” phase; recommended in women and in over-40	Prevention of osteoporosis in women; stimulation of somatic growth	Females: 5–60 mg daily Males: 15–120 mg daily
Oxymetholone	Most powerful AAS on the market; stimulates erythropoiesis	ND	Females: 25 mg each other day (only for international level body builders) Males: 50–200 mg daily
Stanozolol	Large popularity; low risk of side effects; recommended in “cutting” phase; recommended in women	ND	Females: 5–15 mg daily Males: 15–50 mg daily
Testosterone (esters, parenteral use)	(enanthate) ester of testosterone most used in clinical therapeutics; prolonged effects; recommended in “bulking” phase	Treatment of hypogonadism (enanthate)	Females: contraindicated Males: 250–1000 mg weekly
Testosterone undecanoate	Absorption through lymphatics; no first-pass metabolism; one of the most recently developed AAS; orally effective	ND	320–400 mg daily
Trenbolone acetate	Three times more effective than testosterone esters; low risk of side effects; no conversion by 5- α reductase or aromatase	ND	50 mg daily (up to 100 mg daily for “expert users”)

Compounds are listed in alphabetical order.

ND, not declared; AAS, androgenic anabolic steroids.

mood disorders (16, 22.8%), androgenic side effects (unspecified) (15, 21.4%), effects on libido (14, 20.0%), hepatotoxicity (13, 18.6%), virilization (12, 17.1%), lowered voice tone (12, 17.1%), clitoris enlargement (11, 15.7%), blood pressure alterations (11, 15.7%), “oily skin” (10, 14.3%), nausea (nine, 12.8%), alteration of platelet aggregation (eight, 11.4%), menstrual irregularities (six, 8.6%), gastro-

intestinal disorders (four, 5.7%), and increase in body weight (four, 5.7%).

Discussion

The present results provide the first systematic evidence regarding the characteristics of AAS-containing

products available on the Internet, their presentation and accessibility as well as the kind of information provided on the various specialized websites. We will hereafter discuss our result in relation to websites characteristics, product presentation, and additional evidence for the occurrence of misleading and fraudulent practices.

The websites

Evaluation of the characteristics of selected websites suggests that AAS-selling websites tend to specialize either in medicines-like products or in dietary supplements: of the 30 different websites examined, only one sold either product. Websites selling medicine-like products offered on average >52 products, which is more than five times the products offered by dietary supplement-selling websites. The most prominent difference, however, regarded product presentation: products presented as medicines always included in their description the name of the contained AAS, which was always one per product and corresponded to an existing compound. On the contrary, in the majority of cases the AAS compound(s) contained in dietary supplements was not indicated or – whether indicated – it did not correspond to any known compound. Moreover, several dietary supplements were presented as containing more than one (up to six) different compounds, while medicine-like products contained more than one compounds in two cases only (in both cases, a mix of different testosterone salts). These differences, together with the overall appearance of the websites, may suggest that medicine-like products and dietary supplements are targeted to different kinds of users: medicines may be oriented to more “expert” and “demanding” people, while dietary supplements might imply less informed buyers.

In any case, a diffuse lack of transparency and in some cases a clear fraudulent attitude could be identified throughout the majority of the websites, as also suggested by the purchase, payment, and delivery modalities: indeed, none of the websites required a valid prescription for product purchase, several websites reassured about anonymous or even “masked” parcel delivery, and no warranty was usually provided against delivery failure (although the most obvious reason, i.e. custom inspection and subsequent confiscation, was explicitly mentioned).

Finally, in the context of website analysis an additional comment is deserved by the minimum/maximum purchase requirements, since in particular the maximum limits (between US\$500 and US\$2500) indirectly suggest that the purchase of large amounts of products is a common occurrence. Moreover, the additional specification, contained in two websites, that the minimum purchase requirement doubles in

case of delivery addresses with military zip codes [and in particular of the APO/AE type, indicating, according to the Military Postal Service Agency (<http://hqdainet.army.mil/mpsa/>) the geographic location in Europe, Middle East and Africa] raises the issue of AAS use by soldiers, in particular those on missions in foreign countries and/or in war patrol (Bahrke & O'Connor, 1990; Khankhanian et al., 1992; Johnson & Rose, 2006). Indeed, a recent questionnaire-based study of British military personnel located at the Contingency Operating Base in Basra (Iraq), reported that 41% admitted a history of dietary supplement use, and in particular that 1.4% admitted current use of AAS (Boos et al., 2010). The study concludes about evidence for use of AAS being particularly worrying, given both their illegality and their well recognized and deleterious health effects. Further investigation into the specific issue of AAS use by soldiers therefore deserves additional attention, also in view of their easy and convenient accessibility through the Internet and of present circumstantial evidence suggesting specific provisions for military place-based purchasers.

The products

Close examination of the presentation of AAS-containing products provides additional reasons of concern. Interestingly, mentioned benefits were always presented from the point of view of “recreational” users: therapeutic uses were mentioned just in a few instances, while specific emphasis was put on the low risk for adverse effects and on the absence of estrogenic effects, likely one of the main concerns of would-be body builders. This is in line with the observation that the non-AAS products most frequently offered on the various websites were estrogen antagonists, products for erectile dysfunction, and 5 α -reductase inhibitors. Information about benefits and therapeutic uses were in general very limited and misleading. For instance, methandrostenolone was even claimed to act as an anticancer agent, possibly on the basis of a single published study performed in a very particular setting (Bordiushkov et al., 1987).

It is also remarkable that information about possible AAS-related adverse effects was available for at best one out of three products and usually regarded only less serious side effects such as acne, hydic retention (of potential concern for body builders who seek muscle definition), hair loss, hirsutism, and gynecomastia, all of which are likely to be of significant impact on body appearance. Virilization, lowered voice tone, and clitoris enlargement, the most evident and usually irreversible side effects in women, were mentioned in only 15–17% of the products, even if nearly all the products were explicitly recommended for use in women (Table 4).

Nonetheless, indirect evidence for diffuse awareness about the risk of virilization could be indirectly found e.g. in the observation that spironolactone, a potassium-sparing diuretic with antiandrogenic activity (see e.g. Swiglo et al., 2008), was usually included in particular in the so-called “steroid cycles” or “stacks” proposed on nearly half of the examined websites. Hepatotoxicity and mood disturbances were the most serious side effects described, and were mentioned in about one in five products. In any case, no detailed information was given regarding the possible occurrence of hepatic cholestasis or of liver tumors or of hypomania, destructive/self-destructive impulses, or serious depression upon withdrawal (Kicman, 2008). Moreover, the risk of thrombotic events was usually described as “alteration of platelet aggregation” (thus resulting of difficult comprehension for lay people) and the possible occurrence of myocardial infarction, cardiac damage, or sudden cardiac death was never mentioned. This is of further concern in view of the availability on these same AAS-selling websites of several other non AAS anabolic/ergogenic agents, such as growth hormone and insulin, which are known to potentiate AAS-induced heart disease (Kicman, 2008).

Additional concern arises considering recommended doses, which are by far larger than those indicated for therapeutic purposes (Table 4). For instance, therapy with nandrolone is recommended at 25–100 mg every 3–4 weeks, and up to 50–200 mg weekly (Martindale, 2007), while on the various AAS-selling websites nandrolone, which was the AAS most frequently contained in available products, was recommended at doses up to 600–800 mg weekly. Interestingly, recommended doses were provided also for boldenone undecilenate and for trenbolone acetate, which are approved for veterinary use only (Martindale, 2007). It is therefore evident that doses are recommended in the absence of any rational evidence of safety in humans and are therefore at a even higher risk of inducing serious adverse effects (which, however, are described in a very incomplete and misleading fashion, as previously discussed).

Additional understanding of the uses and occurrences in the world of AAS-containing products sold on the web is provided by in-depth examination of data regarding product manufacturers. Although product manufacturers were declared in all but one case for AAS-containing-products sold as medicines and in about two out of three dietary supplements, of course this does not imply by any means that the declared brands are the actual product makers. Moreover, in several cases the declared manufacturers could not be unequivocally traced on the Internet. Closer examination of few examples may provide useful insights. For instance, the home page

of the Eurochem Laboratories website contains a warning indicating that “<http://www.eurochemlabs.com> is the only official site of EuroChem Labs. You can find similar sites with the same content ((<http://www.eurochemlabs.eu>), but they do not have any connection with us. We don’t know who makes these sites and goals they want to achieve. We only know for sure that you cannot trust them” (<http://www.eurochemlabs.com/>, accessed on July 18, 2010), thus suggesting that several counterfeit products illegally using the brand may be available on the market. A similar warning can be found on the website of British Dragon, saying: “<http://www.britishdragon.com> is the only official domain of British Dragon. All other domains that seem to be associated with British Dragon present counterfeit products. The quality of these products is not guaranteed by British Dragon and they are potentially hazardous to your health. British Dragon takes no liability for use of products that cannot be verified as authentic British Dragon product” (<http://www.britishdragon.com>, accessed on July 18, 2010). British Dragon was mentioned on the various AAS-selling websites even as British Dragon Gear Ltd. or as British Dragon Pharmaceuticals. Interestingly, an additional warning was found on British Dragon website, dated Tuesday, May 26, 2009 and saying: “We receive countless email inquiries whether the British Dragon Product purchased is a legitimate British Dragon product, with some people even adding pictures of the received product. Everybody should be aware that British Dragon has not manufactured any products in years and at the moment there are none legitimate British Dragon products available anywhere. New products were not yet made and our best estimate at the moment is September or October. In regards to old batches please understand that they were made 5 or more years ago, and expiry period of our products is not more than 3 Years. So please understand that all products currently offered on the market are 100% counterfeits, regardless of the source” (<http://www.britishdragon.com>, accessed on July 18, 2010).

A different example is represented by LA Pharma (laanabolic.com), which has a website, but is not mentioned in the FDA website and specific pages such as “Authenticity of products” are still under construction (<http://laanabolic.com/authen.htm>, accessed on July 18, 2010). Interestingly, on the FAQs page (<http://laanabolic.com/faqs.htm>, accessed on July 18, 2010) it is said that “the LA Pharma website is established with the purpose of general product information display only” and also that “all raw materials and finished goods were under the quality control in Italy.” The latter claim in particular is generic and lacks any additional specification, possibly suggesting that it is intended to present the

products as accountable and trustworthy, however without any substantial supporting element. According to DomainTools, for LaAnabolic.com the Internet Corporation for Assigned Names and Numbers (ICANN) is Onlinenic.com, an organization which provides hosting services, and it was therefore impossible to retrieve additional information.

A comment is also deserved by Globalanabolic Company Ltd. (<http://www.globalanabolics.com>). For this website, the ICANN registrant is Xin Net Technology Corporation, a registrar in People's Republic of China, which, according to a web page retrieved in the Google cache, went into liquidation in 2006 (in agreement with this news, the corresponding website <http://www.xinnet.com> is presently on sale). According to a document retrieved on Internet, Xin Net in 2007 has "hosted over 18 000 illicit domains, advertised in over 1.7 million unsolicited emails, and corrected exactly none of the 11 000 sites reported to ICANN by KnujOn. Even better, many of the illicit sites are fake pharmacies, and they are still active. And better than that, these sites were all registered by a handful of customers" (Heller, 2008).

Additional evidence for misleading and fraudulent practices

According to our findings, several declared AAS (in particular those contained in dietary supplements) were just deceiving or fake names, e.g. 3-undecanodrol (in some way resembling nandrolone decanoate), cyclostanazol (stanozolol), nandecionate (again, nandrolone decanoate), oxantrione (oxandrolone). Prasterone resembles the proprietary name of a DHEA-containing medicinal (Kocis, 2006), another possible strategy to deceive purchasers. Another indirect evidence, in particular for AAS-containing products sold as medicines, that they might not necessarily contain the compound and/or the amount declared comes from comparison of selling prices with those of corresponding medicines. For instance, nandrolone decanoate-containing medicines are sold in Italy at prices between 33.80 and 49.60 euros/100 mg (CODIFA, <http://www.codifa.it>), while on the web prices were 4.40–9.50 euros/100 mg (Table 2). Assessment of the actual AAS content in products sold over the Internet was well beyond the purposes of the present study; however as the presence of products undeclared (and in particular of AAS) is a well-documented occurrence in particular in dietary supplements (see e.g. Baume et al., 2006 and Geyer et al., 2004), it is also likely that the content of AAS in the products examined in the present study does not correspond to the information provided on the websites: indirect support comes from the relatively low selling prices as well as from the overall misleading and fraudulent attitudes identified in several

websites, and specific studies are therefore warranted.

The use of false brand names and/or fake compounds as well as the development of misleading or even frankly illicit websites, possibly coupled at least in some cases with e-mail spamming, seem therefore common occurrences in the world of AAS products sold on the Internet. It should be also mentioned that an additional source of information on the web about such fraudulent practices is represented by specialized Internet forums: indeed, by reading available discussions on websites such as <http://www.ukmuscle.co.uk>, <http://www.wannabebig.com>, <http://www.anabolicminds.com>, <http://www.ironmagazineforums.com>, <http://www.elitefitness.com>, <http://www.anasci.com>, etc. we collected a surprising amount of detailed information regarding counterfeit products and misleading websites. Formal analysis of such information would deserve an additional study, which could also target the psychological profile of forum users, and was in any case well beyond our present purposes. Nonetheless, the usefulness of such forums as an additional source of information and for the comprehension of the complex world of AAS users must not be underestimated.

Conclusions

We provided a systematic analysis of AAS-selling websites and of the characteristics of sold products. Results document the widespread occurrence of misleading and deceiving practices as well as the lack of transparency and accountability for most of the websites. Specific reasons for concern regarding AAS-containing products include misleading information about expected benefits and risks as well as about recommended uses and doses. Marketing of counterfeit products seems also a common occurrence. The results of the present study emphasize the deleterious potential of AAS-selling websites for public health and provide the basis for direct interventions aimed at repressing the phenomenon of illegal AAS purchasing and for educational and preventive programs specifically targeted toward at-risk categories (Chantal et al., 2009). In particular, both physicians and educators should be aware of the kind of information that is provided to AAS users by AAS-selling websites, and to consider those issues when providing pedagogic interventions to their patients. This should help defining effective strategies to override the common mistrust of AAS users toward professional information and education (Pope et al., 2004). Knowledge of misleading and fraudulent practices adopted by such websites will be of additional benefit for effective educational interventions. Authorities as well should consider this

kind of practices when planning both strengthening of laws as well as preventive and repressive interventions against illegal use of AAS. In view of the rapid and continuous development of Internet and of its profound influence on culture and society, further studies are strongly needed to assess the multiple implications of medicine information and purchasing over the web.

Perspectives

The world traffic of doping substances and in particular of AAS is sharply increasing and the Internet is the main worldwide channel for easy access to drugs and other substances. AAS-selling websites represent a threat to public health; however, no studies so far examined their contents and characteristics. This is the first systematic analysis of AAS-selling websites and of the characteristics of sold products. The results of the present study clearly document the deleterious potential of AAS-selling websites for public health and provide the basis for direct inter-

ventions aimed at repressing the phenomenon of illegal AAS purchasing and for educational and preventive programs specifically targeted toward at-risk categories.

Key words: androgenic anabolic steroids, Internet, websites, purchase.

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