

RESEARCH ARTICLE

Anabolic steroids among resistance training practitioners

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Abstract

Objective

To compare the use of anabolic steroids (AS), the motivation to use them, their side effects, the source of information and the form in which AS were obtained, the medical follow-up, and the periodic examinations in resistance training practitioners who are either current or former users of AS.

Methods

A prevalence survey was performed in the gyms of the city of Curitiba, including 719 current and former AS users who self-administered a questionnaire. The chi-square and z of proportions ($p < 0.05$) statistical tests were conducted.

Results

Esthetics was the main motivation associated with AS intake, leading to satisfactory results. The information about the form in which to use AS was provided by doctors and AS were either purchased at the pharmacy with a prescription or illegally. Current users reported a higher number of cycles and doses, a longer duration of use, as well as larger economical investments into AS. This shows a higher consumption of such drugs, regardless of the medical follow-up and post-cycle therapy.

Conclusion

Given that a change in the usage pattern was observed when increasing the AS consumption, this should be considered in the elaboration of public policies to inhibit such a trend.

Introduction

Anabolic steroids (AS), including testosterone [1] are hormones that are usually used in a therapeutic setting [2–4]. However, they have also been illicitly employed as performance enhancers by professional competitors, school and amateur athletes [5], as well as by college students seeking improved Esthetics [5,6].

The AS medications can be administered either orally or intramuscularly [7] and their periods of use are denominated as cycles. Each cycle can range from 6 to 12 weeks, during which more than one AS administration is usually reported. The pyramid is one of the most common ways of performing a cycle. Specifically, while a gradual increase in the dosage occurs to ensure the adaptation of the body to the high doses, a gradual reduction follows to allow the recovery of the body [8].

The main testosterone drugs used as AS are as follows: Durateston® , Decadurabolin®, Winstrol® and Landerlan® [9–14].

Although the use of AS results in positive effects on performance, such as improvements in both strength and muscle mass [15], their use is also associated with changes in the anxiety and aggression patterns [6]. In addition, depression, personality and mood changes, sleep problems, irritability, and withdrawal symptoms are also common [8]. Furthermore, while women may experience menstrual irregularities, clitoris hypertrophy, uterine and breasts atrophy, men may present a decrease in reproductive hormones, testicular atrophy, impotence, and gynecomastia [16].

Similarly, AS may cause acne, stretch marks, hair growth, voice alterations, pain, and abscesses after the application of injectable AS, liver changes (e.g., cholestasis, adenoma, and carcinoma), and cardiovascular events (e.g., hypertension, thrombosis, arrhythmias, systolic and diastolic dysfunction, left ventricular hypertrophy, and myocardial infarction) [8]. Moreover, the risk of sudden and unexpected death may also increase with AS usage [17, 18]. In addition, although the hospitalizations related to the use of AS are relatively low in Brazil, 1319 hospitalizations (age range: from 15 to 29 years old) were counted between 2000 and 2010, representing a burden for the health system. This number may be even higher given the failures seen in the hospitalization process [19].

Therefore, in addition to the sporting environment, the use of AS represents a problem also for the public health, considering the indiscriminate and non-therapeutic use of such drugs. The present study aims at comparing the use of AS, the motivation to use them, their side effects, the source of information and the form in which AS were obtained, the medical follow-up, and the periodic examinations in weight training practitioners who are either current or former users of AS. Given the possible side effects of the abuse of such drugs, the characterization of the AS form of use presented here is necessary. Furthermore, our results may be important for the foundation of public policies focused on informing and monitoring this publicly.

Materials and methods

An observational cross-sectional prevalence survey was conducted. The project was approved by the Research Ethics Committee of the Pontifical Catholic University of Paraná (PUCPR)—Curitiba—Paraná - Brazil, opinion no. 1,524,203 / 2016. The study met the ethical standards of Harriss et al., 2018 [20].

Specifically, the survey was conducted in the city of Curitiba (Brazil), which has approximately 1.9 million inhabitants and a human development index (HDI) of 0.823 [21]. Fig 1 shows the design of the sampling plan, which includes an initial survey of the number of gyms registered with the Regional Council of Physical Education, i.e., 680 gyms. Successively, only the resistance training centers were selected, leading to a total of 286 gyms. A sample

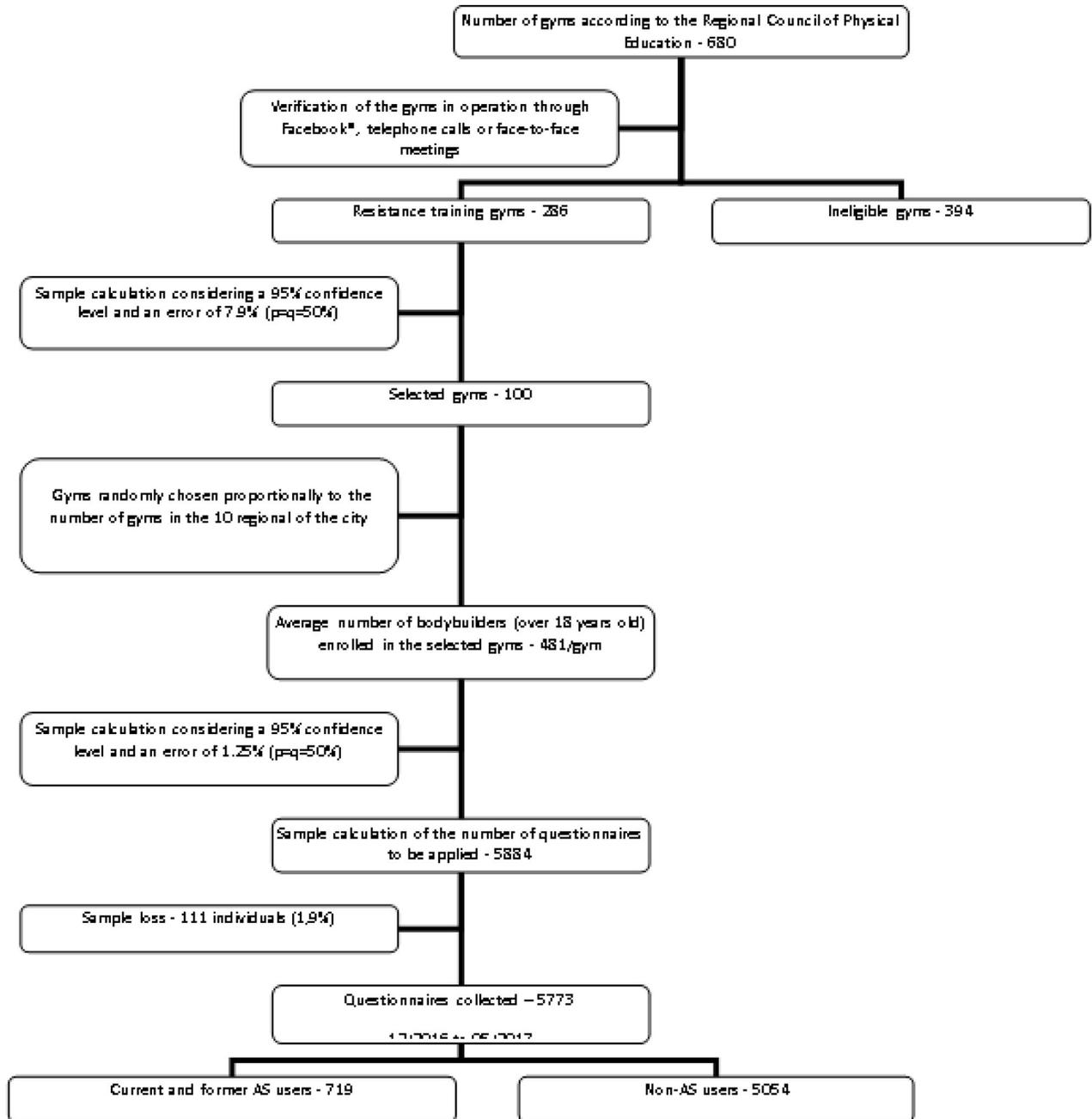


Fig 1. Sampling plan.

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calculation was performed to determine the number of gyms required in this study (considering $p = q = 50\%$), which resulted to be 100 (given an error of 7.9% and a confidence level of 95%). Successively, the average number of students (over 18 years old) enrolled in these gyms was identified, i.e., 481 practitioners. Thereafter, a new sample calculation was performed, considering an error of 1.25% and a 95% confidence level. The survey was applied out to individuals upon entering each gym. The participants signed a disclaimer that explained informed consent, confidentiality, and anonymity for subjects. A sample of 5884 individuals was

obtained. Data were collected between December 2016 and May 2017, in a manner proportional to the number of practitioners present in each gym. Finally, after the exclusion of those individuals who did not use AS, a sample of 719 current and former users of AS resulted.

The questionnaire (S1 and S2 File) was self-administered by participants using the KoboCollect application (KoboCollect, Cambridge, Massachusetts, United States) on the Samsung Tablet, Tab 2 model (Samsung, Campinas, Brazil). This questionnaire was developed for this research and validated through the clarity, construct and content indices. The aspects of construction and content were validated by health professionals, while the clarity aspect was validated with individuals of the same class, age and lifestyle of the individuals who would be researched. A pilot study was conducted that the questionnaire could be used with the intended population. The questionnaire briefly, it comprised a first part to be answered by all the resistance training practitioners participating in this research and a second part to be answered only by current and former users of AS. This second part was analyzed in the present study, as it contained questions that addressed the age at AS use onset, the number of cycles performed, the cycle length, the weekly dosage, the type of AS used, the money invested in AS, AS used, the knowledge about the post-cycle therapy (PCT), the motivation to use AS, the satisfaction with the results, the source of information about AS, the form in which AS were obtained, the medical follow-up, the periodic exams and the changes in such exams.

Successively, all the data were transferred from the Kobocollect application (KoboCollect, Cambridge, Massachusetts) to the Excel (Microsoft, Redmond, Washington) and IBM SPSS 20.0 (IBM SPSS, Armonk, New York) software. The exploratory descriptive statistics of the frequency distribution and the percentages were performed using the results presented in the tables. With regards to the inferential analyzes, the chi-square test and the z-test of proportions were conducted, in addition to the student's t-test to compare the means (significant difference at $p < 0.05$).

Results

In the sample studied, 73% of the practitioners were former users of AS, while 27% were current users (men: 77.7%; women: 22.3%). However, when comparing the former and current users, differences between men and women were not observed ($p = 0.09$). Furthermore, the mean age of the participants was similar between men (30.4 ± 7.0 years) and women (30.8 ± 7.4 years) ($p = 0.57$), also when considering both former (30.8 ± 7.0 years) and current (29.8 ± 7.2 years) users ($p = 0.08$).

The majority of the current and former users began to use AS between their 18 and 29 years of age (73.1%), with 6.7% of them starting before their 18 years of age. Specifically, the mean age at onset among the former (24.8 ± 6.0 years) and current (25.0 ± 6.7 years) users was similar ($p = 0.79$).

The highest percentage of the former users consumed AS for a period of time longer than one year (66.3%): 19.2, 17.5, 29.6, 14.5, and 19.2% used it for more than five and three years, one year, and six and three months, respectively.

Table 1 compares the current and former users of AS. While a higher percentage of former users only performed one cycle of AS, six cycles or more were reported by current users. In addition, a shorter duration of one to two months per cycle was mainly observed in former users, whereas cycles with a duration longer than five months were mostly found among current users. Moreover, while a dosage of 100 mg per week was commonly reported by former users, dosages higher than 301 mg per week were described by current users. In addition, injectable AS were mostly employed by current users. Furthermore, a higher percentage of former users invested up to US\$ 134 for buying AS, whereas values over US\$ 134 were described by current users. However, the use of AS related to esthetic reasons and curiosity was higher

Table 1. Comparison of the number and duration of AS cycles, the dosage and type of AS used, the money invested, AS used, the motivation for the use of AS, and the subsequent satisfaction between former and current users of AS; Curitiba, 2016/2017.

Variables	Total n (%)	Former Users n (%)–n M–n F	Current Users n (%)–n M–n F	P
Number of Cycles				
Only 1	331 (46%)	284 _a (54,1%)– 208–76	47 _b (24,2%)– 35–12	0,0001
2 to 5	281 (39,1%)	199 _a (37,9%)– 154–45	82 _a (42,3%)– 62–20	
6 or more	107 (14,9%)	42 _a (8,0%)– 38–4	65 _b (33,5%)– 62–3	
Duration of the cycle				
1 to 2 months	376 (52,3%)	315 _a (60,0%)– 242–73	61 _b (31,4%)– 47–14	0,0001
3 to 4 months	189 (26,3%)	128 _a (24,4%)– 100–28	61 _a (31,4%)– 48–13	
5 to 6 months	58 (8,1%)	33 _a (6,3%)– 27–6	25 _b (12,9%)– 22–3	
7 to 12 months	36 (5,0%)	14 _a (2,7%)– 10–4	22 _b (11,3%)– 18–4	
More than 12 months	60 (8,3%)	35 _a (6,7%)– 21–14	25 _b (12,9%)– 24–1	
Dosage per week				
Unknown	176 (24,5%)	149 _a (28,4%)– 110–39	27 _b (13,9%)– 20–7	0,0001
Up to 100 mg	296 (41,2%)	241 _a (45,9%)– 178–73	55 _b (28,4%)– 32–23	
101 mg to 300 mg	108 (15,0%)	76 _a (14,5%)– 67–9	32 _a (16,6%)– 28–4	
301 mg to 500 mg	64 (8,9%)	34 _a (6,5%)– 31–3	30 _b (15,5%)– 30–0	
501 mg to 700 mg	22 (3,1%)	8 _a (1,5%)– 8–0	14 _b (7,2%)– 14–0	
Above 700 mg	53 (7,4%)	17 _a (3,2%)– 16–1	36 _b (18,6%)– 35–1	
Type				
Injectable	566 (78,7%)	400 _a (76,2%)– 339–61	166 _b (85,6%)– 140–26	0,006
Oral	427 (59,4%)	301 _a (57,3%)– 204–97	126 _a (64,9%)– 100–26	0,065
Other	16 (2,2%)	11 _a (2,1%)– 7–4	5 _a (2,6%)– 3–2	0,697
Value invested				
Up to US\$ 134	362 (56,3%)	299 _a (64,6%)– 207–92	63 _b (35,0%)– 46–17	0,0001
US\$ 135 to US\$ 269	139 (21,6%)	86 _a (18,6%)– 78–8	53 _b (29,4%)– 43–10	
More than US\$ 270	142 (22,1%)	78 _a (16,8%)– 65–3	64 _b (35,6%)– 60–4	
Motivation				
Esthetic	538 (74,8%)	406 _a (77,3%)– 302–104	132 _b (68,0%)– 109–23	0,011
Sports Performance	262 (36,4%)	185 _a (35,2%)– 155–30	77 _a (39,7%)– 67–10	0,271
Bodybuilding	131 (18,2%)	56 _a (10,7%)– 43–13	75 _b (38,7%)– 65–10	0,0001
Curiosity	85 (11,8%)	75 _a (14,3%)– 64–11	10 _b (5,2%)– 8–2	0,001
Therapeutic	18 (2,5%)	12 _a (2,3%)– 10–2	6 _a (3,1%)– 6–0	0,539
Other	10 (1,4%)	7 _a (1,3%)– 6–1	3 _a (1,5%)– 2–1	0,829
Satisfaction after use				
Yes	613 (85,3%)	428 _a (81,5%)– 329–99	185 _b (95,4%)– 151–34	0,0001
No	106 (14,7%)	97 _a (18,5%)– 71–26	9 _b (4,6%)– 8–1	
AS used				
Stanozolol	436 (60,6%)	308 _a (58,7%)– 258–50	128 _a (66,0%)– 112–16	0,075
Phenylpropionate, isocaproate, propionate and decanoate testosterone	332 (46,2%)	217 _a (41,3%)– 214–3	115 _b (59,3%)– 112–3	0,0001
Oxandrolone	329 (45,8%)	214 _a (40,8%)– 127–87	115 _b (59,3%)– 86–29	0,0001
Nandrolone decanoate	235 (32,7%)	142 _a (27,0%)– 136–6	93 _b (47,9%)– 87–6	0,0001
Methandrostenolone	165 (22,9%)	89 _a (17,0%)– 84–5	76 _b (39,2%)– 76–0	0,0001
Testosterone cypionate	163 (22,7%)	85 _a (16,2%)– 84–1	78 _b (40,2%)– 77–1	0,0001
Trembolone	162 (22,5%)	75 _a (14,3%)– 70–5	87 _b (44,8%)– 84–3	0,0001
Boldenone Undecylate	129 (17,9%)	51 _a (9,7%)– 40–11	78 _b (40,2%)– 68–10	0,0001
Drostanolone propionate	109 (15,2%)	46 _a (8,8%)– 37–9	63 _b (32,5%)– 58–5	0,0001
Oxymethalone	94 (13,1%)	59 _a (11,2%)– 57–2	35 _b (18,0%)– 34–1	0,016

(Continued)

Table 1. (Continued)

Variables	Total n (%)	Former Users n (%)–n M–n F	Current Users n (%)–n M–n F	P
Other	43 (6,0%)	30 _a (5,7%)– 20–10	13 _a (6,7%)– 9–4	0,620

Proportion z test. The different letters in the lines indicate significant differences ($p < 0.05$). US\$: American dollar (exchange of 10/31/2018). n M: number of male. n F: number of female.

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among former users. Specifically, of those who were curious, 60.1% only performed one cycle ($p = 0.029$). In contrast, the use of AS for bodybuilding was greater in current users. Of the satisfied individuals, there was a higher percentage of current users.

Winstrol® (stanozolol) was the most commonly used AS by both current and former users. However, a greater diversity of AS was consumed by current users, including Durates-ton® (phenylpropionate, isocaproate, propionate and decanoate testosterone), Landerlan® (oxandrolone), Deca-Durabolin® (nandrolone decanoate), Dianabol® (methandrostenolone), Deposteron® testosterone), Parabolan® (trenbolone), Boldenone® (boldenone undecylated), Masteron® (drostanolone propionate), and Hemogenin® (oximethalone).

Table 2 shows the presence of collateral symptoms in both current and former users, as well as their disappearance after the end of the cycle. A higher percentage of the following symptoms was observed among current users: increased libido, acne appearance, irritability/aggressiveness, hypertension, depression, and dependence.

Table 3 illustrates that a higher percentage of current users obtained the information related to AS from doctors and nutritionists. In addition, a higher percentage of current users received AS either through a prescription in the pharmacy or in other ways, including the black market or imports. Furthermore, a higher percentage of current users reported medical follow-ups and periodic exams (e.g., total testosterone dosage) given their usage of AS. Moreover, changes in the results of such tests were identified, mainly among the current users. Finally, a higher percentage of current users was aware of the PCT and performed it similarly to previous users.

Discussion

One of the strengths of the present study relies on its large sample size, i.e., 719 weight training practitioners who are either current or former users of AS. Our results reveal differences between these groups, which were mainly related to the form of use: the number and duration of the AS cycles, the amount of money invested in them, the type of AS, the dosage used, and their motivation to consume them. Furthermore, differences were observed in the source of information related to the drugs, the way in which AS were obtained and the conduction of medical follow-ups.

In the current study, a higher number of former rather than current users of AS was observed, in accordance with previous literature [22, 23]. While Silva & Moreau (2003) [22] and Leifman et al., (2011) [23] separated current (17 and 5, respectively) from former (23 and 62, respectively) users into two categories, all the other surveys grouped them into a single category, making their comparison not possible. Furthermore, a larger number of current and former male users was here found, in accordance with previous literature [24, 13, 25, 26].

Practitioners' mean age was similar between men and women, as well as between current and former users. However, although our averages are above the age ranges described in other studies [27, 10, 9], the mean corroborates with the values seen in the literature if the age at onset of AS use is considered. It is also worth mentioning that 6.7% of the individuals started the use of AS at an age younger than 18 years old, as evidenced in other studies [28–31].

Table 2. Presence of collateral symptoms in both current and former users, as well as their disappearance after the end of the cycle.

Variables	Total n (%)	Former Users n (%)	Current Users n (%)	P
Collateral Symptoms				
Yes	643 (89,4%)	466 _a (88,8%)	177 _a (91,2%)	0,338
No	76 (10,6%)	59 _a (11,2%)	17 _a (8,8%)	
Symptoms				
Increased Libido	327 (45,5%)	213 _a (40,6%)	114 _b (58,8%)	0,0001
Acne	308 (42,8%)	213 _a (40,6%)	95 _b (49,0%)	0,043
Irritability / Aggressiveness	233 (32,4%)	157 _a (29,9%)	76 _b (39,2%)	0,018
Headache	159 (22,1%)	119 _a (22,7%)	40 _a (20,6%)	0,557
Decreased Libido	111 (15,4%)	77 _a (14,7%)	34 _a (17,5%)	0,346
Gynecomastia	97 (13,5%)	63 _a (12,0%)	34 _a (17,5%)	0,054
Hypertension	91 (12,7%)	55 _a (10,5%)	36 _b (18,6%)	0,004
Change in Menstrual Cycle	73 (10,2%)	58 _a (11,0%)	15 _a (7,7%)	0,191
Deepening of the Voice	71 (9,9%)	50 _a (9,5%)	21 _a (10,8%)	0,604
Depression	50 (7,0%)	26 _a (5,0%)	24 _b (12,4%)	0,001
Dependency	31 (4,3%)	16 _a (3,0%)	15 _b (7,7%)	0,006
Vomiting / Nausea	25 (3,5%)	17 _a (3,2%)	8 _a (4,1%)	0,545
Other	59 (8,2%)	48 _a (9,1%)	11 _a (5,7%)	0,132
Symptoms Disappeared After Cycle				
Yes	555 (77,2%)	415 _a (79,0%)	140 _a (72,2%)	0,025
No	98 (13,6%)	71 _a (13,5%)	27 _a (13,9%)	
Some	66 (9,2%)	39 _a (7,4%)	27 _b (13,9%)	

Proportion z test. The different letters in the lines indicate significant differences ($p < 0.05$).

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Our results identified that a higher percentage of former, as opposed to current, users only conducted one AS cycle, with a shorter duration (1 to 2 months) and smaller dosages (100 mg). This strengthens the hypothesis of a curiosity-driven AS use, given that the percentage of former users who reported such a reason was also higher. In contrast, the opposite was observed in current users, who performed six or more cycles, with longer durations (5 months or more) and higher dosages (301 mg or more) than former users. While the satisfaction associated with the results can be one of the motivating hypotheses behind the regular use of AS, the practice of bodybuilding may also be an explanation to this phenomenon, since the motivation to consume AS was also greater in current users.

Injectable AS were mostly used, mainly among current users. To the best of our knowledge, this is the first study identifying the frequency of AS administration forms in this population. With regards to injectable AS, a lack of proper asepsis care during the application increases the risk of infections. As a consequence, this may lead to hospitalizations given the practitioners' progression to abscesses, which may turn into more severe conditions, such as muscular necrosis or sepsis [32]. With regards to oral AS, high hepatotoxicity is expected [33, 16].

In accordance with the literature, testosterone and stanozolol were the most commonly used AS [22, 34, 35]. Although a previous study cited testosterone as commonly used AS [33], oxandrolone, which had a high prevalence in this study, was not widely assessed in other studies.

Stanozolol was the most used AS among both groups, in accordance with Silva and Moreau (2003) [22], possibly given its popular brands that can be found both in the oral and injectable forms [36]. Similarly, nandrolone decanoate was also commonly consumed in other studies [9, 11, 22, 35, 37], possibly considering its higher accessibility (i.e., lower cost in trade) and greater

Table 3. Comparison of the source of information related to AS, the way in which the AS was obtained, the medical follow-up and exams, alterations in such exams, and the knowledge and conduction of the PCT between former and current users of AS; Curitiba, 2016/2017.

Variables	Total n (%)	Former Users n (%)	Current Users n (%)	P
Information Source				
Doctors	331 (46,0%)	214 _a (40,8%)	117 _b (60,3%)	0,0001
Friends	254 (35,3%)	193 _a (36,8%)	61 _a (31,4%)	0,185
Coaches	226 (31,4%)	156 _a (29,7%)	70 _a (36,1%)	0,103
Internet	155 (21,6%)	119 _a (22,7%)	36 _a (18,6%)	0,234
Nutritionist	109 (15,2%)	68 _a (13,0%)	41 _b (21,1%)	0,007
Other	34 (4,7%)	25 _a (4,8%)	9 _a (4,6%)	0,945
Way of obtaining the AS				
Friends	394 (54,8%)	291 _a (55,4%)	103 _a (53,1%)	0,576
Pharmacy with prescription	271 (37,3%)	183 _a (34,9%)	88 _b (45,4%)	0,010
Pharmacy without prescription	77 (10,7%)	55 _a (10,5%)	22 _a (11,3%)	0,739
Other	119 (16,6%)	77 _a (14,7%)	42 _b (21,6%)	0,025
Medical follow-up				
Yes	281 (39,1%)	157 _a (29,9%)	124 _b (63,9%)	0,0001
No	438 (60,9%)	368 _a (70,1%)	70 _b (36,1%)	
Conducting examinations				
Yes	521 (72,5%)	358 _a (68,2%)	163 _b (84,0%)	0,0001
No	198 (27,5%)	167 _a (31,8%)	31 _b (16,0%)	
Exams				
Total Testosterone	402 (55,9%)	257 _a (49,0%)	145 _b (74,7%)	0,0001
Cholesterol	399 (55,5%)	272 _a (51,8%)	127 _b (65,5%)	0,001
High density lipoprotein—HDL	378 (52,6%)	254 _a (48,4%)	124 _b (63,9%)	0,0001
Low density lipoprotein—LDL	357 (36,0%)	238 _a (45,3%)	119 _b (61,3%)	0,0001
Cortisol	259 (36,0%)	161 _a (30,7%)	98 _b (50,5%)	0,0001
Alanine Aminotransferase—ALT	246 (34,2%)	146 _a (27,8%)	100 _b (51,5%)	0,0001
Aspartate Aminotransferase—AST	243 (33,8%)	146 _a (27,8%)	97 _b (50,0%)	0,0001
Follicle Stimulating Hormone— FSH	243 (33,8%)	147 _a (28,0%)	96 _b (49,5%)	0,0001
Progesterone	218 (30,3%)	129 _a (24,6%)	89 _b (45,9%)	0,0001
Other	68 (9,5%)	41 _a (7,8%)	27 _b (13,9%)	0,013
Do not Know	51 (7,1%)	34 _a (6,5%)	17 _a (8,8%)	0,289
Exams alterations				
Yes	201 (28,0%)	112 _a (21,3%)	89 _b (45,9%)	0,0001
No	518 (72,0%)	413 _a (78,7%)	105 _b (54,1%)	
Knowledge PCT				
Yes	567 (78,9%)	391 _a (74,5%)	176 _b (90,7%)	0,0001
No	152 (21,1%)	134 _a (25,5%)	18 _b (9,3%)	
Realization PCT				
Yes	288 (40,1%)	176 _a (33,5%)	112 _b (57,7%)	0,0001
No	431 (59,9%)	349 _a (66,5%)	82 _b (42,3%)	

Proportion z test. The different letters in the lines indicate significant differences (p <0.05).

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disclosure [36]. Both stanozolol and nandrolone decanoate are frequently used for muscle growth, given their higher anabolic characteristics compared to androgenic AS [36].

Although more than one AS is usually used during a cycle [8], veterinary drugs, such as boldenone undecylation and trenbolone, have also been consumed [12]. A report of fulminant

heart attack due to the use of boldenone in humans was reported [38]. In contrast, trenbolone may affect the liver, causing cholestatic hepatitis [39, 40] and may be associated with the proliferation of tumor cells in prostate cancers [41]. In addition, it can result in dermatitis, including severe inflammatory acne with pustules and hemorrhagic ulcerations [42].

Collateral symptoms were reported by both current and former users, as widely reported in previous literature [5, 8, 16]. However, while most symptoms disappeared after the end of the cycle, given their acuity, the chronic symptoms observed may cause slow and irreversible changes [8].

In accordance with previous studies, increased libido, acne, and irritability/aggressiveness were the main collateral symptoms reported by both current and former users [22, 9]. Increased libido may be classified as an acute side effect, given that it again decreases after the cycle [15], and it is associated with high serum levels of testosterone resulting from the use of supraphysiological dosages [5]. In contrast, considering that acne usually occurs during puberty and not in adulthood, the use of AS increases the activity of the sebaceous glands, which leads to higher oil concentrations present in the skin [8]. Furthermore, irritability/aggressiveness are often associated with the AS use [8]. Although increased aggression may lead to heightened violence, such a hypothesis was not previously proven, given that the individuals involved in cases of violence also used other drugs, alcohol or had personality tendencies [24].

Transient hypertension, an acute symptom, was more frequent in current users [16]. However, this acute symptom may become chronic, since the use of AS for long periods is associated with cardiovascular diseases, including hypertension, heart attack, and stroke. The most commonly used oral AS alter the levels of lipoproteins that carry the cholesterol in the blood, increase the level of low-density lipoprotein (LDL), and decrease the high-density lipoprotein (HDL) instead [8]. Therefore, their assessment is important for controlling health-related risks [22]. Moreover, current users were noticed to be more cautious compared to former users, possibly because they underwent more medical follow-ups.

Dependency was also more frequent in current users. The use of AS for long periods of time may eventually affect the brain as other addictive illicit drugs, acting primarily on the dopamine, serotonin, and opioid systems [8]. However, dependency may also be associated with the presence of body image disorders, such as "muscular dysmorphism", where excessive preoccupation is laid onto the musculature [24]. Moreover, the stories of success disseminated by the means of communication related to image alteration and muscular bodies motivates such body transformations [12].

A higher percentage of current users obtained information about AS from doctors. In fact, the emergence of anti-aging treatments increases the number of doctors who encourage AS therapies [43]. However, attention is drawn to the fact that doctors are prescribing such therapies to youngsters, who fail in conducting a medical follow-up, representing a big issue [13]. Therefore, the increased number of doctors prescribing the use of AS may be stimulating its use. In fact, the acquisition of such drugs in the pharmacy with a prescription was high, as described in previous literature [22, 33]. Moreover, friends, coaches, and nutritionists also influence the use of AS [44, 9]. In fact, coaches encourage their clients to consume AS for better results in the shortest time possible to improve their reputation in the academy [27].

This study did not find a definite protocol for the use of AS. Various combination, dosages, durations, and cycles were in fact used by practitioners. An empirical culture on how to best use AS according to the final objective exists, which can either be obtained from manuals or transmitted orally between users (based on their own experiences) [22]. Furthermore, this information, as well as the AS products, are widely found on the internet.

In accordance to previous studies, in addition to pharmacies, AS were found to be also illegally marketed (black market) and easy to access [33, 45, 9]. In fact, AS are marketed freely on

the internet and in the gyms themselves [36]. About 1/3 of the illicitly imported products derive from Paraguay, according to the federal police of Brazil. It should be noted that these products are not regulated and that they may be falsified [46], leading to possible serious health damages.

Although most of the individuals do not conduct a medical follow-up, a higher percentage of current users performed monitoring and tests to control for the risks associated with the use of AS, including changes in vital organs (e.g., heart and liver) and dosage of testosterone. However, performing these tests does not eliminate health risks [22].

Although a great knowledge about PCT exists, a small number of individuals actually perform such a therapy. Briefly, PCT involves the use of certain medications aimed at reversing the suppression of endogenous production of testosterone at least temporarily. Its abrupt interruption, without returning to the endogenous production, can lead to a state of hypogonadism characterized by a substantial loss of muscle mass, reduced energy levels, depression, and loss of libido. However, a higher percentage of current users are performing PCT, which may be a result of the increased number of medical follow-ups conducted in this group⁷. In the present study, the following drugs used during PCT were identified: tamoxifen, human chorionic gonadotropin hormone (CGH), Clomiphene, Anastrozole, Saw Palmetto, Legalon, and Proviron. These drugs were prescribed for such a therapy in previous literature [7].

The limitations of the current study will now be highlighted. Firstly, a response bias may have affected our results, considering that the answers provided in the self-administered questionnaire depended on the participant's honesty and that confirming their veracity was not possible. In addition, as some of the information refer to a period in the past (even years before the current investigation), especially with regards to former users, uncertainties regarding the information provided may be present.

Conclusions

Most current users performed between two to five and up to six or more cycles of AS, with a duration of five months or more and a dosage higher than 301 mg per week. They consumed the injectable type of AS, invested an amount of money higher than US\$ 134 and used stanozolol. Esthetics was found to be the main reason associated with the use of such drugs and individuals were satisfied with the obtained results. Although they presented side-effects during the period of use (mainly increased libido, irritability/aggressiveness, and acne appearance), such symptoms disappeared after the use. The information related to the use of AS was mainly obtained through doctors and the drugs were purchased either through friends or at a pharmacy with a prescription. Individuals conducted medical follow-ups, had a knowledge of PCT and performed it. In contrast, most former users only conducted one cycle of AS, for a duration of one to two months, with dosages lower than 100 mg per week. They invested less than US\$ 134 in AS, did not conduct medical follow-ups and did not perform PCT.

Overall, we noticed some changes in the pattern of use between former and current users of AS. Specifically, the latter reported a higher number of cycles of AS, a longer duration, increased dosage and money invested in AS, and a consequent higher and diverse consumption of AS. However, the presence of collateral symptoms does not inhibit such a consumption, possibly due to the safety provided by the medical follow-ups, which were conducted by a high number of current users. Finally, an increase in both the number of doctors providing such services and the acquisition of AS in pharmacies with a prescription was observed. This implies the need for public policies ensuring both improved information, given the symptoms and risks presented, and better control, considering that the abuse of such drugs is associated with a number of health risks.

Supporting information

S1 File. Portuguese questionnaire.

(DOC)

S2 File. Questionnaire.

(DOC)

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