Onterecht gebruik van androgenen

Avondcolloquium
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Androgen use vs. misuse vs. abuse

Table 1. Classification of use, misuse, and abuse of androgens

	Therapeutic status	Application
Use	Physiological replacement therapy	Pathological (organic) hypogonadism
	Pharmacological androgen treatment	Non-reproductive disorders including functional low testosterone states
		Masculinizing female-to-male transgender (transmen)
Misuse	Invalid indication	Misinformation and/or misapplication
		Male infertility; obesity, diabetes, osteoporosis, erectile dysfunction in absence of pathological hypogonadism
		"Andropause," "LowT," "late-onset hypogonadism"
Abuse	No medical indications	Elite sport performance
		Image enhancement and bodybuilding for cosmetic, recreation or occupational reasons

Handelsman D. Androgen Misuse and Abuse. Endocrine Reviews 2021;4:457–501

Androgen use

Table 1. Classification of use, misuse, and abuse of androgens

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Table 2. Pharmacological androgen therapy

Target tissue	Clinical indication	Status
Spermatogenesis	Hormonal male contraception	Proven principle (phase II-III trials of prototype), no product
	Male infertility	Disproven
Hemoglobin	Renal or marrow failure	Proven second-line therapy, cost-effective *vs* erythropoietin
Bone	Osteoporosis	Proven second-line therapy, less effective than bone anabolic drugs
	Steroid-induced bone loss	Proven adjuvant therapy, not widely used
Muscle	HIV wasting/cachexia	Proven second-line therapy
	Genetic myopathies	Disproven
Psychosexual	Male sexual dysfunction	Disproven (eugonadal men)
	Female sexual dysfunction	Proven (at supraphysiological levels)
Transgender	Female-to-male transgender	Widely adopted standard of care
Mood	Depression, quality of life	Modest efficacy (dysthymia), not tested *vs* antidepressants
Anti-estrogen	Advanced breast cancer	Proven, last resort
	Endometriosis	Proven, second-line therapy *vs* GnRH agonists
Liver	Angioedema (C1 esterase deficiency)	Proven, cost-effective vs recombinant C1 esterase

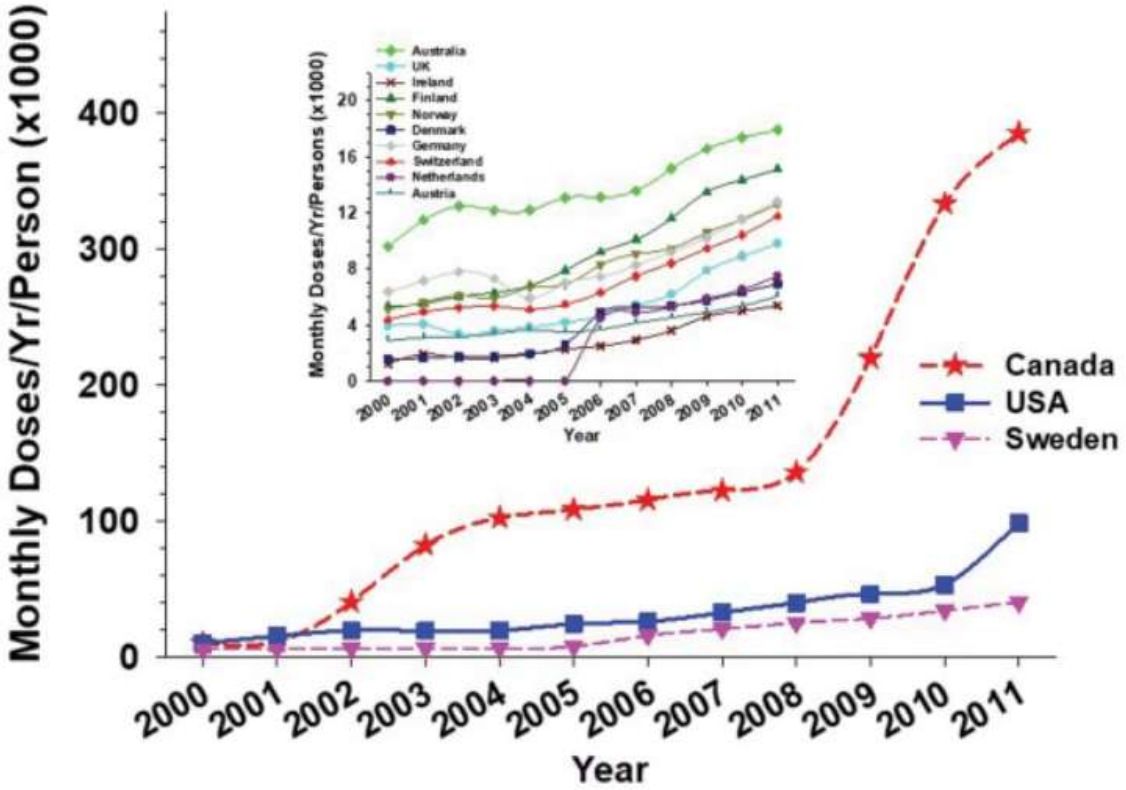
Handelsman D. Androgen Misuse and Abuse. Endocrine Reviews 2021;4:457–501

Androgen misuse

Table 1. Classification of use, misuse, and abuse of androgens

	Therapeutic status	Application
Misuse	Invalid indication	Misinformation and/or misapplication
		Male infertility; obesity, diabetes, osteoporosis, erectile dysfunction in absence of pathological hypogonadism
		"Andropause," "LowT," "late-onset hypogonadism"

Lucas Cranach The Fountain of Youth



Global Pharma Sales of Testosterone

1988 - $18 million
2011 - $1.8 billion
100-fold rise in 30 yr.

Research Letter

December 2022

Guideline-Discordant Care Among Direct-to-Consumer Testosterone Therapy Platforms

Justin M. Dubin, MD[1]; Erin Jesse, MD[2]; Richard J. Fantus, MD[3]; et al

» Author Affiliations | Article Information

JAMA Intern Med. 2022;182(12):1321-1323. doi:10.1001/jamainternmed.2022.4928

Table 1. Characteristics of Online Direct-to-Consumer Platforms Offering Testosterone Therapy

Characteristic	Platform 1	2	3	4	5	6	7
Type of consultation	Telephone call	Telephone call	Video call	Telephone call	Video call	Video call	Video call
Type of provider	Nonmedically licensed individual	Nurse practitioner	Nurse practitioner	Physician assistant	Physician assistant	Nurse practitioner	Nurse practitioner and nonmedically licensed individual
History obtained by provider							
Current testosterone deficiency symptoms	No	Yes	Yes	Yes	No	Yes	Yes
Past medical history	No	Yes	Yes	Yes	Yes	Yes	Yes
Past surgical history	No	No	Yes	No	No	No	Yes
Social history	No	Yes	Yes	Yes	No	Yes	No
Review of systems	No	Yes	Yes	Yes	Yes	Yes	Yes
History of testosterone therapy use	No	Yes	Yes	Yes	No	Yes	No
Recent CV events	No	No	Yes	No	No	No	No
Desire for future fertility	No	Yes	No	No	No	No	No
Total testosterone level considered "below normal" during patient counseling, ng/dL	NS	<550	<450	NS	<400	<400	NS
Provider stated goal of total testosterone range, ng/ dL	NS	1000-1500	NA	NS	>800	1000-1200	1000-1200
Provider stated goal of free testosterone range, pg/dL	25-35	20-30	NA	>20	NS	NS	NS
Testosterone therapy offered to secret shopper	Yes	Yes	No	Yes	Yes	Yes	Yes
Testosterone therapy formulations offered	Intramuscular	Intramuscular, transdermal	NA	Intramuscular, transdermal	Intramuscular	Intramuscular, subcutaneous, oral troche	Intramuscular
Testosterone therapy effects on fertility discussed	No	No	NA	Yes	No	Yes	Yes
Risk of polycythemia with testosterone therapy discussed	No	No	NA	No	Yes	No	No
Intramuscular injection education offered	Recommended YouTube	Recommended YouTube	NA	None	Video provided	None	None
Other medications offered	Clomiphene, desiccated thyroid, DHEA and pregnenolone, HCG, sildenafil, tadalafil	Anastrozole, HCG	Apomorphine, GHRH analog (CJC 1295), ipamorelin, oxytocin, tadalafil	Anastrozole, clomiphene, DHEA, HCG, liothyronine, sildenafil, tadalafil, vitamin D	Anastrozole, gonadorelin, sildenafil	Anastrozole, clomiphene, HCG, multinutrient supplement 1[a], multinutrient supplement 2[b]	DHEA, gonadorelin, kisspeptin
Time to first follow-up	2-3 mo	2-2.5 mo	1.5 mo[c]	3 mo	3 mo	1.5-2 mo	2 mo
Recommended frequency of follow-up	Every 4-6 mo	Every 6 mo	Every 3 mo[c]	Every 6 mo	Every 12 mo	Every 6 mo	Every 12 mo

Abbreviations: CV, cardiovascular; DHEA, dehydroepiandrosterone; GHRH, growth hormone-releasing hormone; HCG, human chorionic gonadotropin; NA, not applicable (testosterone therapy not offered by provider); NS, not specified by provider.

SI conversion factor: To convert testosterone to nanomoles per liter, multiply by 0.0347.

[a] Eicosapentaenoic acid, docosahexaenoic acid, ω-3, and docosapentaenoic acid.

[b] Vitamin A, vitamin C, vitamin E, niacin, vitamin B_6, vitamin B_{12}, pantothenic acid, eleuthero root extract, rhodiola rosea root extract, schisandra berry extract, ashwagandha root extract, and licorice root extract.

[c] No laboratory test values required at time of follow-up.

BOX 1

Avoiding Testosterone Misuse

- Testosterone is highly susceptible to wishful thinking, marketing, and promotion leading to its use as an anti-aging or sexual dysfunction tonic and for cyberchondria.
- Hypogonadism is a clinical diagnosis with a pathological basis, confirmed by hormone assays—not the other way around.
- Testosterone misuse is prescribing for wrong reasons: harmful, invalid, or unproven off-label indications, most often for inappropriate or unproven clinical context.
- The invented condition known variously as "andropause," "LowT," "late onset hypogonadism," or "age-related or functional hypogonadism" is a fiction in search of a definition.
- Functional hypogonadism is not a disease, and testosterone treatment is not justified without sound evidence of efficacy and safety from placebo-controlled clinical trials.
- Take care to distinguish pathological from functional hypogonadism.
- Beware of disease mongering: watch the objective evidence and beware of indications stretched beyond valid evidence.
- Be prepared to say you do not know when you do not.
- Avoid testosterone prescribing solely because another doctor might do so or that underlying nonreproductive causes of a low testosterone might seem irremediable.

Mismeasure Leads to Misuse

- There is no basis for population screening for low testosterone.
- Avoid "case-finding" in men with nonspecific clinical features without evidence of pathologic hypogonadism.
- Without likely underlying reproductive pathology, there is no reason to measure serum testosterone.
- To measure serum testosterone, the testes should be examined and underlying reproductive pathology suspected.
- Always measure serum LH, FSH, and SHBG with testosterone for interpretation and obtain multiple samples.
- Encourage pathologists to provide accurate serum testosterone by liquid chromatography-mass spectrometry; the steroid immunoassay era of 20th century is ending.
- Imaginary, derived fractions of testosterone ("free," "bioavailable") are a numerical artifact signifying nothing and provide no reliable clinical guidance on androgen status.

Androgen abuse

Table 1. Classification of use, misuse, and abuse of androgens

	Therapeutic status	Application
Abuse	No medical indications	Elite sport performance Image enhancement and bodybuilding for cosmetic, recreation or occupational reasons

- PIEDs = performance- and image-enhancing drugs
- AAS = anabolic androgenic steroids

- Since 1950's: androgen abuse in athletes
- Since 1980's: crossover as 'endemic drug subculture'

Epidemiologie

The global epidemiology of anabolic-androgenic steroid use: a meta-analysis and meta-regression analysis

Dominic Sagoe MPhil, PhD Cand [a,*], Helge Molde PhD [b], Cecilie S. Andreassen PhD [a,c], Torbjørn Torsheim PhD [a], Ståle Pallesen PhD [a]

Table 2
Prevalence rates, CIs, and heterogeneity statistics for the overall population, males, and females

	N	p%	95% CI	Q	df (Q)	I^2
Overall	271	3.3	2.8–3.8	86828.2*	270	99.7
Male	112	6.4	5.3–7.7	13626.6*	110	99.2
Female†	83	1.6	1.3–1.9	2525.1*	82	96.8

df (Q) – Q's degrees of freedom; I^2 – heterogeneity index; N – number of studies; p% – prevalence (%); Q – heterogeneity statistic.
* $P < .001$.
† p% is significantly lower than p% for males ($P < .001$).

Table 3
Regional prevalence rates, 95% CIs, and heterogeneity statistics

	N	p%	95% CI	Q	df (Q)	I^2
Middle East	7	21.7	13.5–32.9	138.8*	6	95.7
Trans-Region	2	6.0	0.1–79.5	281.4*	1	99.6
South America	5	4.8	1.2–16.7	397.0*	4	99.0
Europe	81	3.8	2.4–5.8	60009.6*	80	99.9
North America†	126	3.0	2.7–3.4	14752.7*	125	99.2
Oceania†	38	2.6	2.1–3.3	2705.0*	37	98.6
Africa†	11	2.4	1.2–4.8	208.7*	10	95.2
Asia	1	0.2	0–3.5	0ns	0	0

df (Q) – Q's degrees of freedom; I^2 – heterogeneity index; N – number of studies; ns – not significant; p% – prevalence (%); Q – heterogeneity statistic.

Table 4
Prevalence rates, 95% CIs, and heterogeneity statistics for sample type

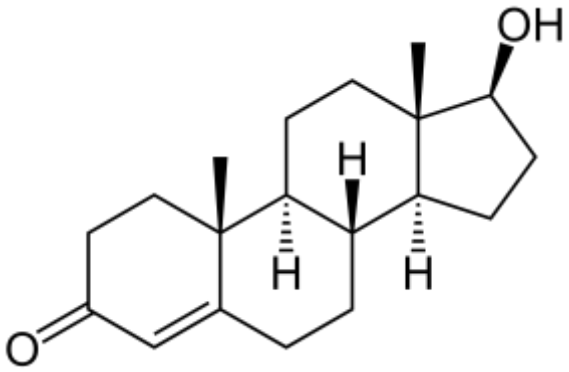
	N	p%	95% CI	Q	df (Q)	I^2
Recreational sportspeople	18	18.4	11.2–28.6	1125.0*	17	98.5
Athletes	48	13.4	9.7–18.2	4484.7*	47	99.0
Prisoners and arrestees	6	12.4	5.8–24.7	114.7*	5	95.6
Drug users	20	8.0	3.6–16.8	2417.2*	19	99.2
High school†	109	2.3	2.1–2.5	7930.1*	108	98.6
Non-athletes†	70	1.0	0.7–1.3	9818.0*	69	99.3

df (Q) – Q's degrees of freedom; I^2 – heterogeneity index; N – number of studies; p% – prevalence (%); Q – heterogeneity statistic.
* $P < .001$.
† p% is significantly lower than p% in recreational sportspeople ($P < .001$); p% is significantly lower than p% in athletes ($P < .001$); p% is significantly lower than p% in prisoners and arrestees ($P < .001$); p% is significantly lower than p% in drug users.
† p% is significantly lower than p% in high school ($P < .001$).

Farmacologische androgeenderivaten

- Testosteron & derivaten

Testosterone

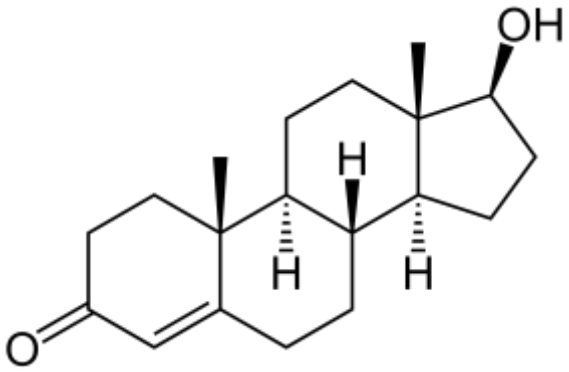


- Rapid hepatic conversion (first-pass effect)
- Short circulating half-life
- Low oral bioavailability
- Transdermal use: depot in stratum corneum

Farmacologische androgeenderivaten

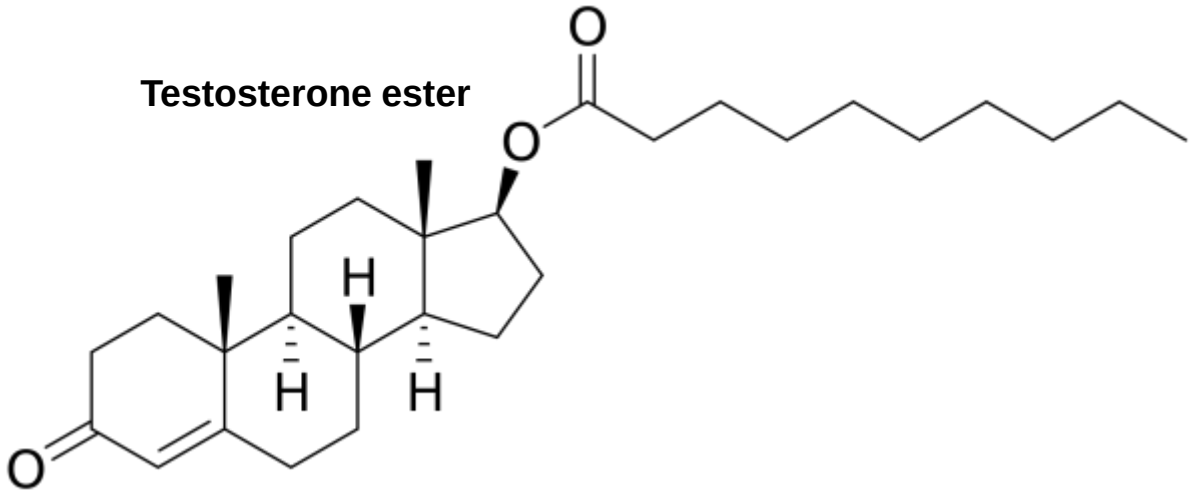
- Testosteron & derivaten

Testosterone



- Rapid hepatic conversion (first-pass effect)
- Short circulating half-life
- Low oral bioavailability
- Transdermal use: depot in stratum corneum

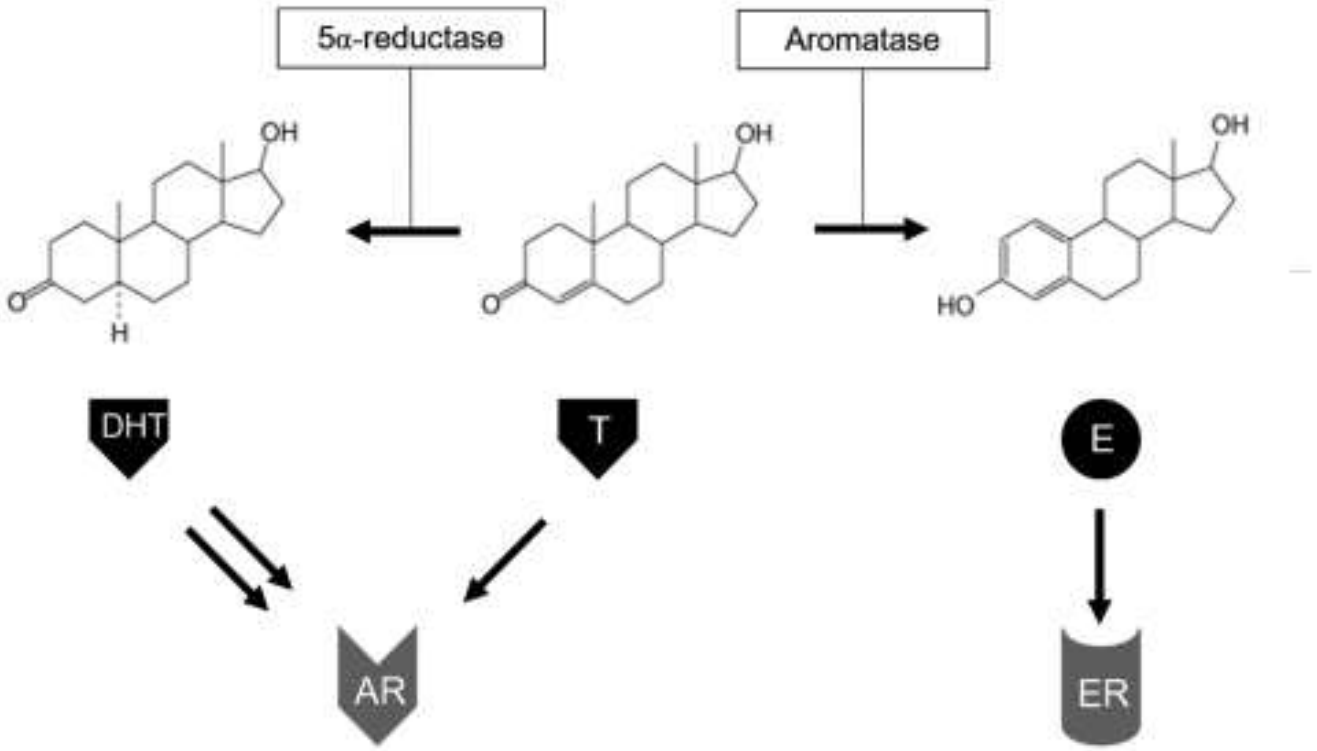
Testosterone ester



- IM depot
- Bypass first-pass effect
- Extended half-life

Farmacologische androgeenderivaten

- Testosteron & derivaten



Virilization
Male-pattern baldness
Increased body hair

Gynaecomastia

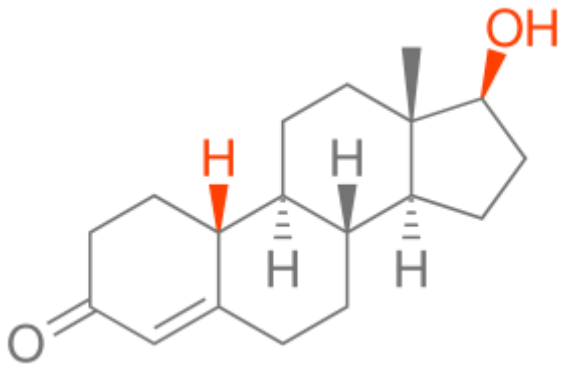
- Anabolic but less virilizing steroids ?
  - Preventing aromatization and/or 5α-reduction ?
  - Tissue-selectivity?
- Oral formulations ?

Smit D. Health effects of anabolic androgenic steroid use in male amateur athletes. 2022.

Farmacologische androgeenderivaten

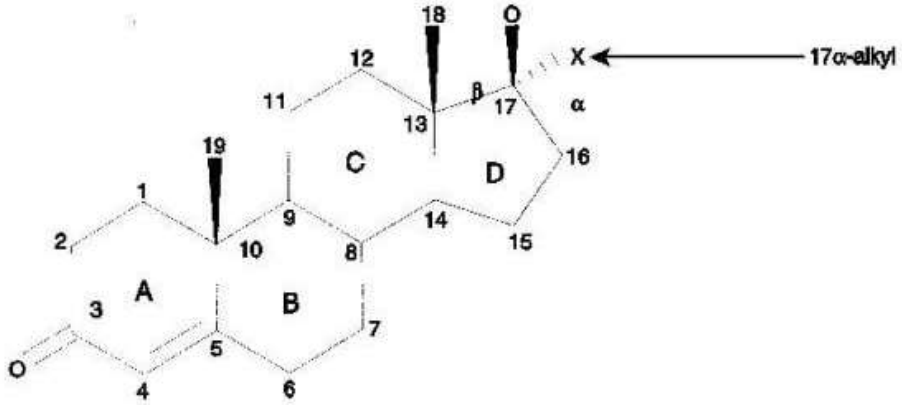
- Steroidale synthetische androgenen

Nandrolone (19-nortestosteron) + esters



- Anabolic effects > androgenic effects (?)
- Aromatization ↓
- IM (esters)

17α-alkylated testosterone derivatives



- Oral bioavailability
- Resist hepatic conversion
- Hepatotoxicity
- (high estrogenic activity)

Farmacologische androgeenderivaten

- Niet-steroidale synthetische androgenen

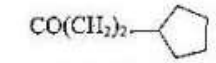
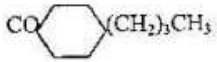
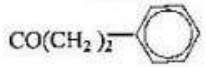
  - Afgeleid van niet-steroidale *anti*-androgenen vb. bicalutamide (Casodex®) of andere molecule
  - Geen aromatisatie / 5α-reductie
  - Geen first pass effect

  - Weefselspecificiteit?
    - ‘SARM’ = selective androgen receptor modulator
    - Experimentele fase !

  - Hepatotoxiciteit?

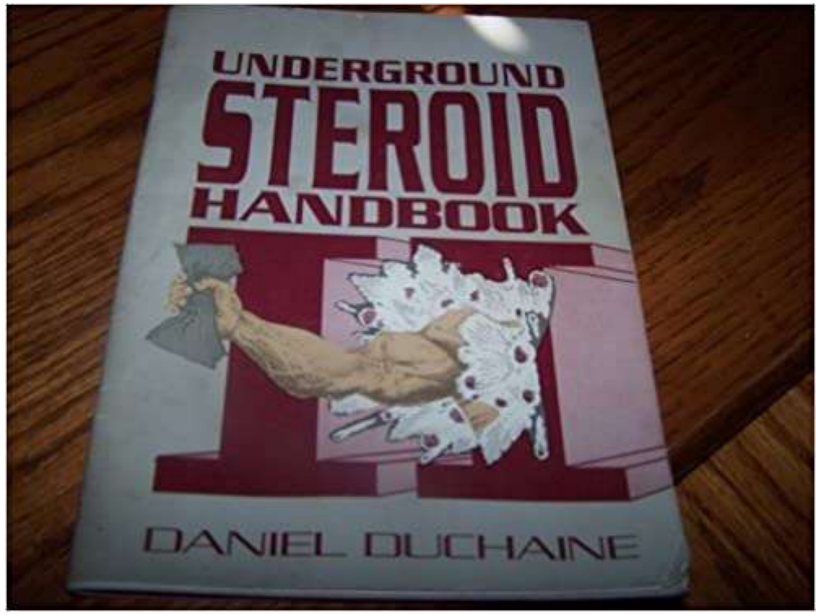
Farmacologische androgeenderivaten

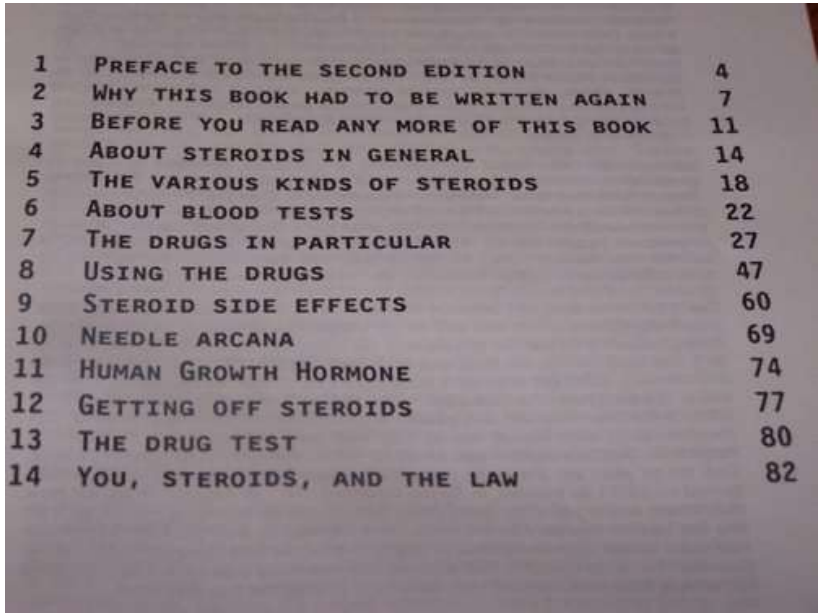
- Ever-marketed vs. designer drugs
- Unregulated OTC / internet-marketed food supplements
  - Often not identified as steroids
  - Cross-contamination
- Supply through underground networks, minority from valid medical prescriptions

GENERIC NAME	YEAR OF PATENT	R (17β)	X (17α)	OTHER MODIFICATIONS
NATURAL ANDROGENS				
Testosterone		H	H	
5α-Dihydrotestosterone	1960	H	H	4,5-ane
UNMODIFIED 17β ESTERS				
Testosterone propionate	1941	$COCH_2CH_3$	H	
Testosterone cypionate	1956	$CO(CH_2)_2$- 	H	
Testosterone enanthate	1958	$CO(CH_2)_5CH_3$	H	
Testosterone undecanoate	1975	$CO(CH_2)_9CH_3$	H	
Testosterone buciclate	1987	CO-  -$(CH_2)_3CH_3$	H	
MODIFIED ANDROGENS				
Methenolone	1958	H	H	4,5-ane :1,2-ene :1-CH_3
Nandrolone	1955	H	H	19-norCH_3
Mesterolone	1962	H	H	4,5-ane :1α-CH_3
MENT (7α-methyl nandrolone)	1994	H	H	19-norCH_3 :7α-CH_3
MODIFIED 17β ESTERS				
Methenolone acetate	1958	$COCH_3$	H	4,5-ane :1,2-ene :1-CH_3
Nandrolone phenylpropionate	1959	$CO(CH_2)_2$- 	H	19-norCH_3
Nandrolone decanoate	1961	$CO(CH_2)_8CH_3$	H	19-norCH_3
17α ALKYLATION				
Methyltestosterone	1945	H	CH_3	
Fluoxymesterone	1957	H	CH_3	9α-F :11β-OH
Methandrostenolone	1959	H	CH_3	1,2-ene
Oxandrolone	1964	H	CH_3	4,5-ane :C2-replaced by O
Oxymetholone	1959	H	CH_3	4,5-ane :2-methyleneOH
Stanozolol	1962	H	CH_3	4,5-ane :[2,3-c]pyrazole :2,3-ene
Danazol	1962	H	C≡CH	2,3-ene :[2,3-d]isoxazole}
Norethandrolone	1955	H	CH_2CH_3	19-norCH_3
Ethylestrenol	1959	H	CH_2CH_3	19-norCH_3 :3-H_2

Gebruikswijze

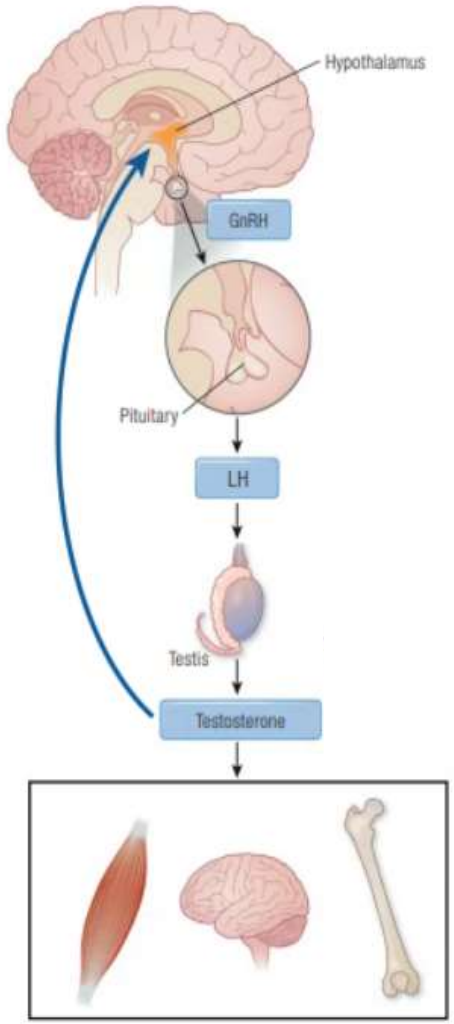
- Intermittent use: cycling
  - 6-12 weeks (pyramidal regimen)
  - With / without post-cycle therapy (SERM / AI / HCG)
- Blast and cruise strategy
  - Maintenance dose used in between cycles
- ‘Testosterone replacement therapy’ after cycling
- …



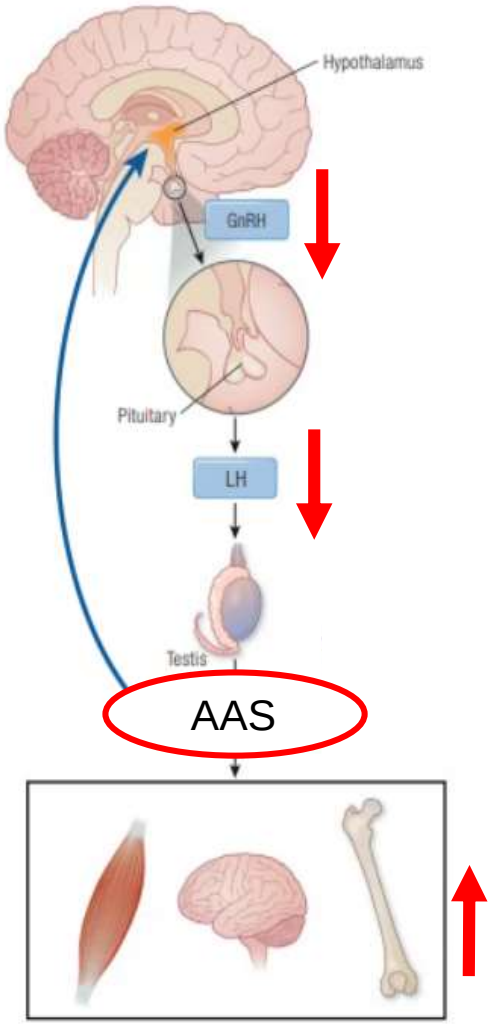


Cyclus van afhankelijkheid

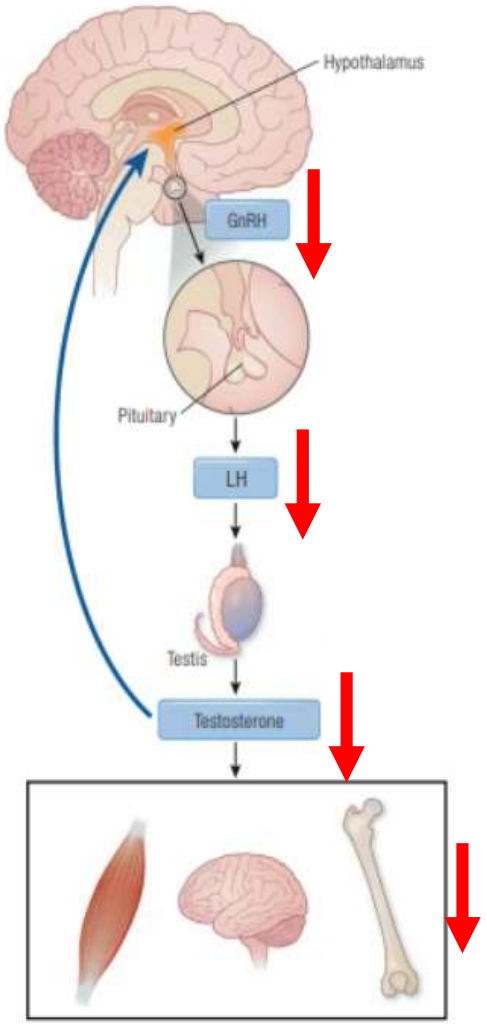
Physiologic



AAS abuse

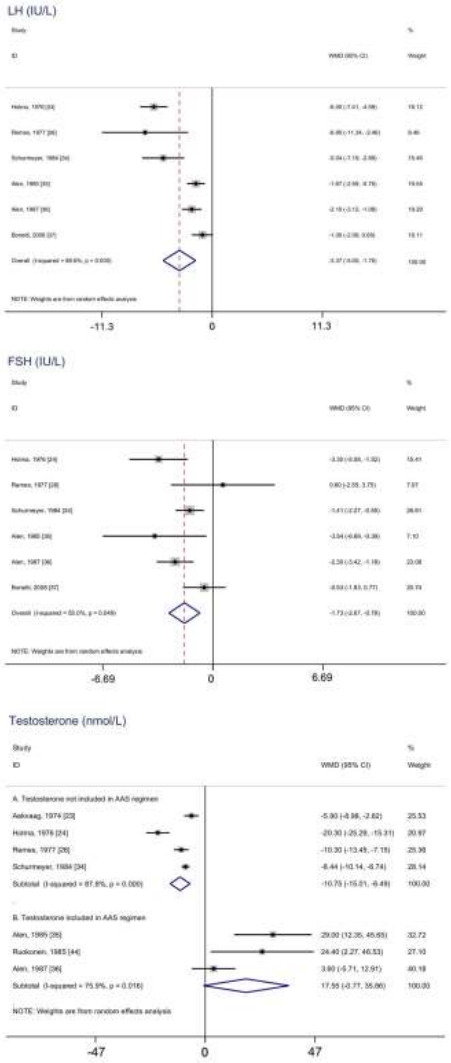


AAS withdrawal

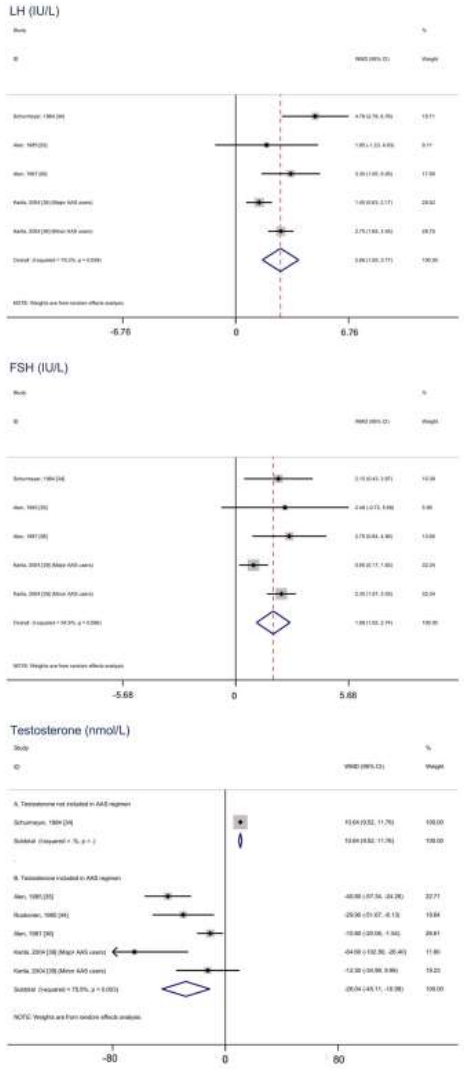


Bijwerkingen: reproductieve hormonen

During use



After cessation



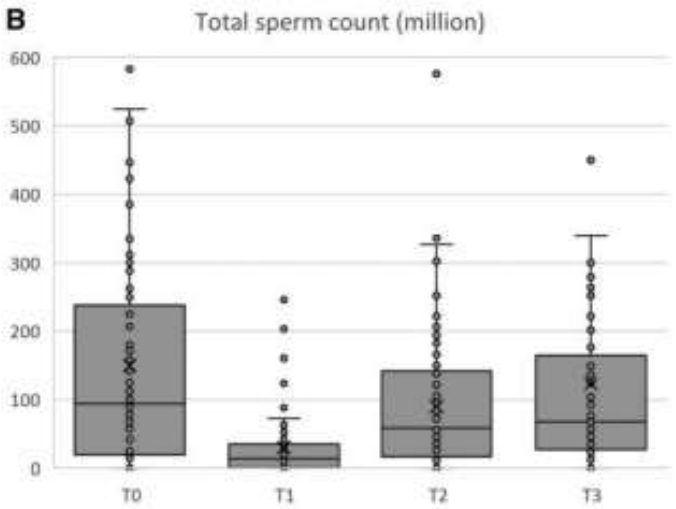
Key Points

This is the first systematic review and meta-analysis of the effects of anabolic androgenic steroid use on the reproductive system of athletes and recreational users.

Anabolic androgenic steroid use results in a state of prolonged hypogonadotropic hypogonadism in male individuals; gonadotropin levels recover after 13–24 weeks, whereas serum testosterone does not appear to recover, remaining reduced at 16 weeks following discontinuation of anabolic androgenic steroids.

Christou M. et al. Effects of Anabolic Androgenic Steroids on the Reproductive System of Athletes and Recreational Users: A Systematic Review and Meta-Analysis. Sports Med 2017.

Bijwerkingen: spermatogenese en testiculair volume



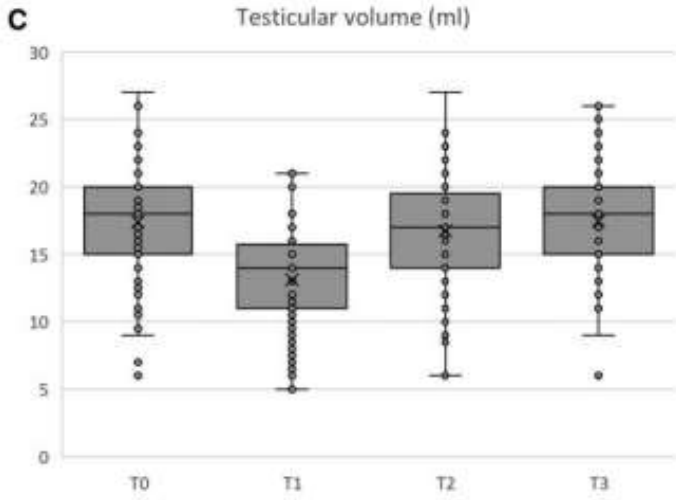


Table II Results of semen analysis (including testicular volume) during clinic visits.

Semen analysis (units, RR)	T_0 (n = 94) $\bar{x}$ [CI] n (%)	T_1 (n = 91) $\bar{x}$ [CI] n (%)	T_2 (n = 84) $\bar{x}$ [CI] n (%)	T_3 (n = 73) $\bar{x}$ [CI] n (%)
Semen volume (ml, ≥2.0)	3.1 [2.8–3.4]	2.4‡ [2.1–2.8]	2.7† [2.3–3.0]	2.7† [2.3–3.0]
	29 (31%)	42‡ (45%)	107 31 (37%)	107 21 (29%)
Concentration ($\times 10^6$/ml, ≥15)	46.8 [40.1–53.6]	11.7‡ [5.0–18.7]	36.4‡ [28.6–42.8]	44.0 [35.8–50.9]
	24 (26%)	62‡ (68%)	28 (33%)	21 (29%)
Total sperm count ($\times 10^6$, ≥40)	145 [124–174]	30.0‡ [4.9–55.2]	87.9‡ [62.0–114]	120† [92.5–147]
	27 (28%)	70‡ (77%)	34 (40%)	25 (34%)
Progressive motility (%, ≥32%)	47.1 [42.7–50.5]	32.8‡ [28.0–36.3]	43.5 [39.0–47.1]	46.7 [41.7–50.2]
	16 (18%)	36‡ (48%)	24† (29%)	15 (21%)
Total motile sperm count ($\times 10^6$, ≥10)	77.2 [63.6–90.8]	13.0‡ [−0.8–26.8]	43.1‡ [27.9–56.4]	62.7 [46.1–76.3]
	22 (23%)	62‡ (68%)	24 (29%)	17 (23%)
Mean testicular volume (ml, ≥12)	17.4 [16.6–18.2]	13.2‡ [12.4–14.0]	16.7† [15.9–17.4]	17.5 [16.6–18.3]
	11 (12%)	28 (31%)‡	10 (12%)	102 6 (8%)

The mean ($\bar{x}$) of every parameter with 95% CI, as well as the number of subjects (n) had a result outside the RR are displayed. T_0, before the start of the cycle; T_1, in the last week of the cycle; T_2, 3 months after the cycle; T_3, 1 year after the start of the cycle. CI and *P*-values were calculated with mixed models and compare visit T_1, T_2 and T_3 with T_0. †P = 0.01–0.05, ‡P < 0.001.

T1 = Last week of cycle
T2 = 3 months after start of cycle
T3 = 1 year after start of cycle

Smit D et al. Disruption and recovery of testicular function during and after androgen abuse: the HAARLEM study. Hum Reprod 2021.

Bijwerkingen: spermatogenese en testiculair volume

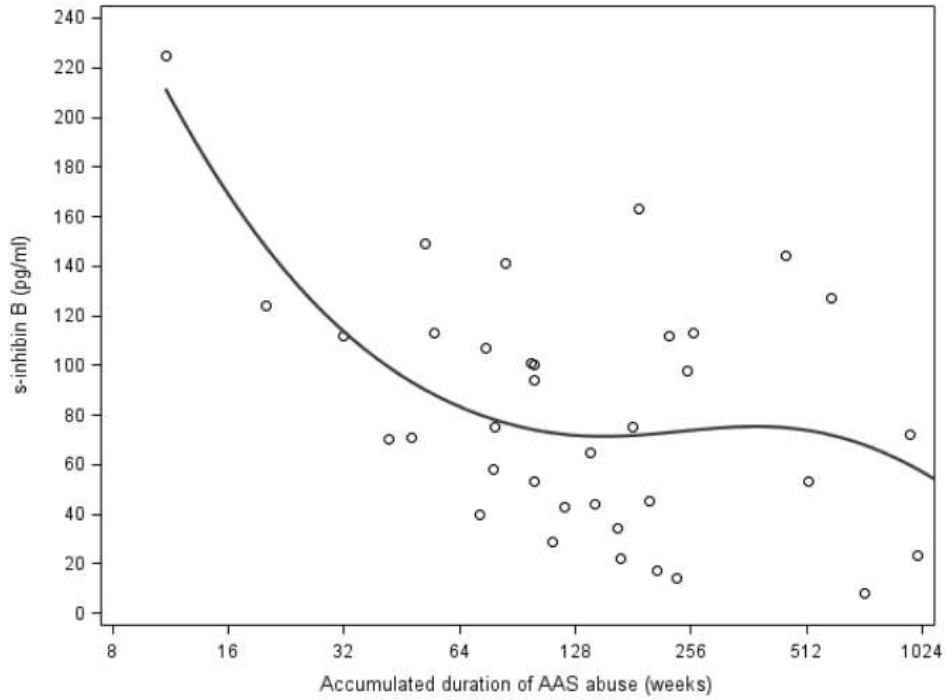


Fig 4. Association between accumulated duration of AAS abuse (log 2 scale spline function) and serum inhibin B levels in current AAS abusers. Footnote: AAS, anabolic androgenic steroids; **s-**, serum.

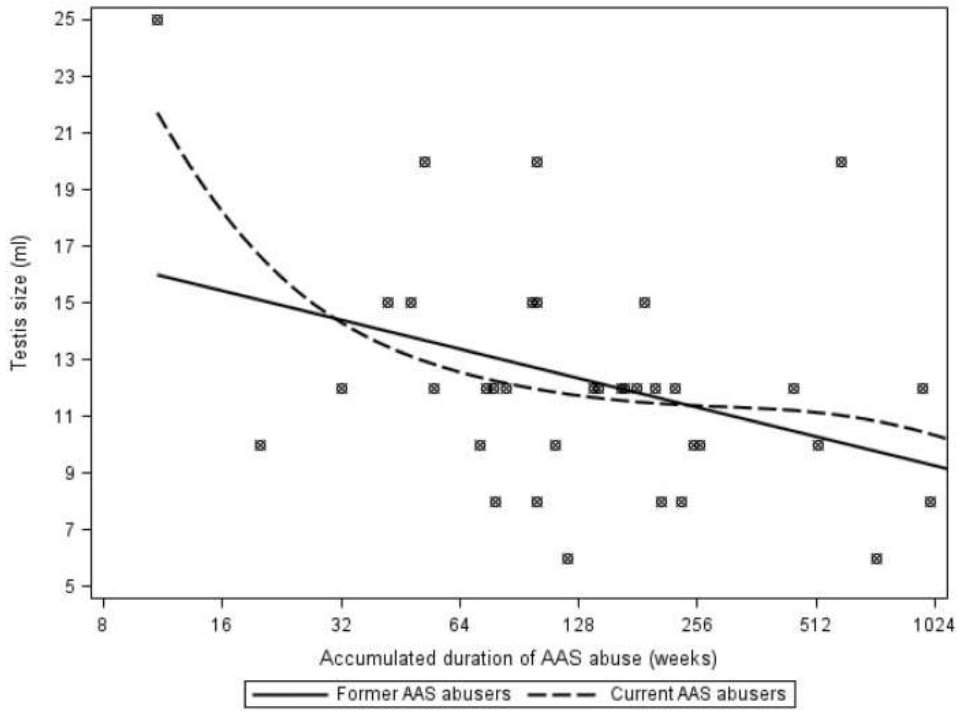


Fig 1. Association between accumulated duration of AAS abuse (log 2 scale) and testis size in current AAS abusers (spline function) and former AAS abusers. Footnote: AAS, anabolic androgenic steroids.

Rasmussen J et al. Former Abusers of Anabolic Androgenic Steroids Exhibit Decreased Testosterone Levels and Hypogonadal Symptoms Years after Cessation: A Case-Control Study. Plos One 2016.

Bijwerkingen: seksuele functie

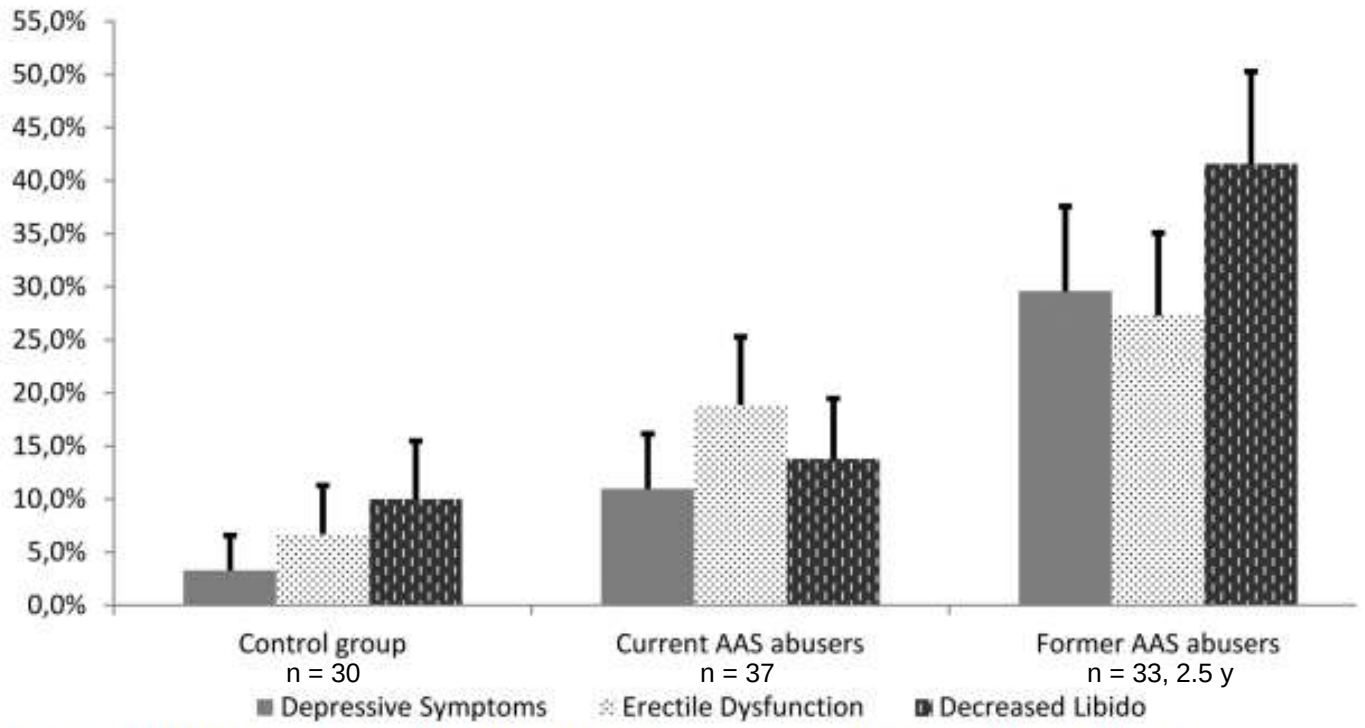
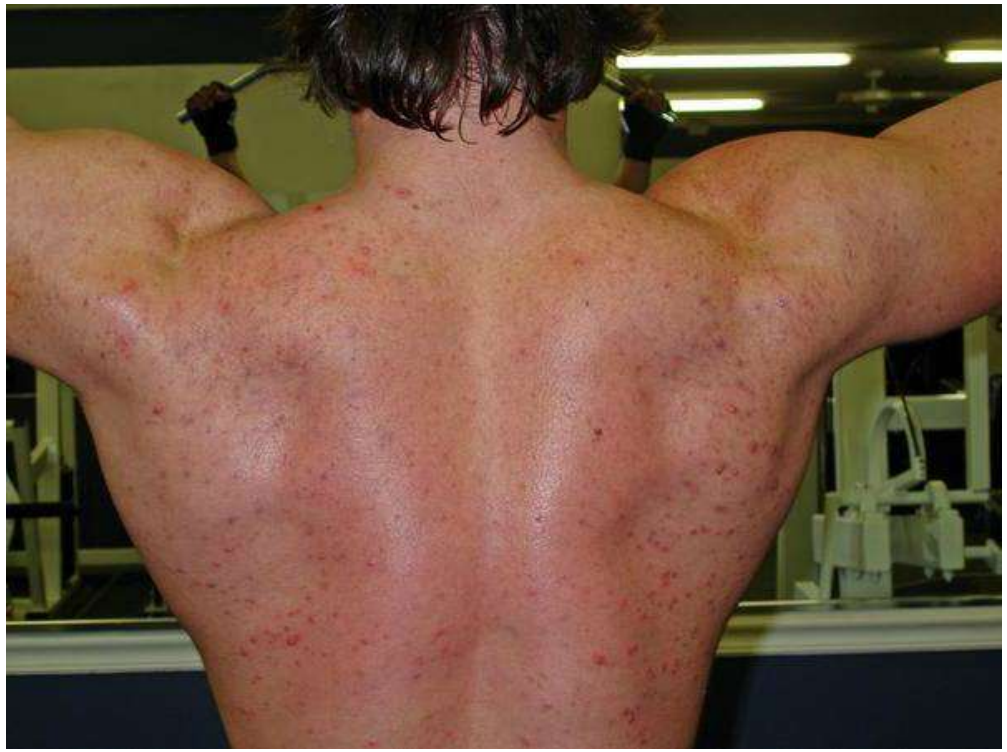


Fig 6. Symptoms of depression, erectile dysfunction and decreased libido in the three groups. Footnote: T bars show standard errors. Depressive symptoms, erectile dysfunction and decreased libido were compared across the groups with trend analyses and all were statistically significant ($P < 0.05$). **AAS,** anabolic androgenic steroids.

doi:10.1371/journal.pone.0161208.g006

Rasmussen J et al. Former Abusers of Anabolic Androgenic Steroids Exhibit Decreased Testosterone Levels and Hypogonadal Symptoms Years after Cessation: A Case-Control Study. Plos One 2016.

Andere androgeengerelateerde bijwerkingen



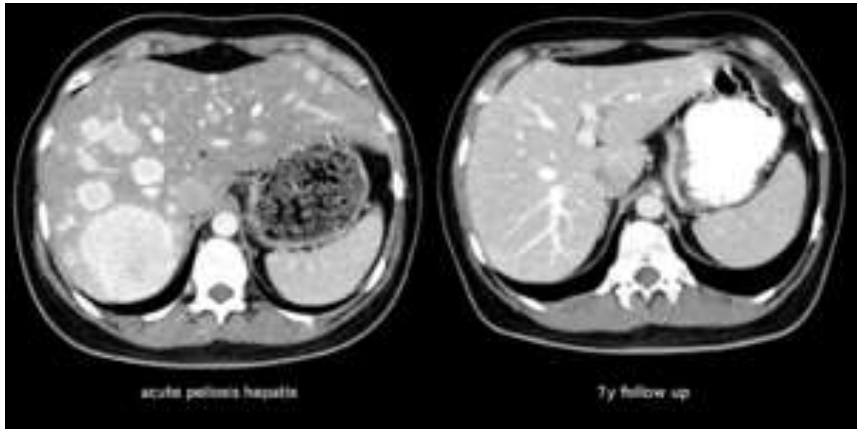
Truncal acne (52%)

Gynaecomastia (26%)

Hepatotoxiciteit

- Klassespecifiek: 17α-alkylated AAS (methyltestosterone, oxandrolone, oxymetholone, stanozolol)
- SARMs ?

- Cholestase
- Icterus
- Adenoma / carconma
- Peliosis hepatis



- Grotendeels reversibel

- Mechanisme onduidelijk (rol van oxidatieve stress?)

Cardiovasculaire effecten

- Atherogeniciteit
  - Premature atherosclerose
  - AMI, stroke
- Trombogeen effect
  - DVT, longembool
  - Perifeer vaatlijden
- Vasospasme
- Cardiotoxiciteit:
  - Cardiomyopathie
  - Hartfalen

Anabolic Androgenic Steroids Induce Reversible Left Ventricular Hypertrophy and Cardiac Dysfunction. Echocardiography Results of the HAARLEM Study

Diederik L. Smit[1], A. J. Voogel[2], Martin den Heijer[3] and Willem de Ronde[1]*

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Background: The use of anabolic androgenic steroids (AAS) is not uncommon among strength athletes. Several cross-sectional studies have linked AAS use to heart disease, but a causal role for AAS is not certain and it is unknown whether cardiac changes are reversible.

Methods: Men of at least 18 years old intending to start an AAS cycle on short notice were included for comprehensive 3D echocardiographic examination before (T_0), at the end of the cycle (T_1), and 1 year after inclusion (T_2) after a recovery period. Details of the AAS cycle performed and the use of other performance and image-enhancing drugs (PIEDs) as well as illicit drug use were recorded. Trend analysis and multivariable regression analysis were performed with mixed effects linear models.

Results: Thirty-one subjects were included. Between start (T_0) and end of the cycle (T_1), after a median AAS cycle duration of 16 weeks, 3D left ventricular ejection fraction declined with 4.9% (CI −7.2 to −2.5, $P < 0.001$), E/A-ratio declined with−0.45 (CI −0.69 to −0.21, $P < 0.001$), and 3D left atrial volume increased with 9.2 ml (CI 2.9–15.4, $P = 0.004$). Left ventricular mass increased with 28.3 g (CI 14.2–42.4, $P < 0.001$) and was positively correlated with AAS average weekly dose. After a median recovery time of 8 months (T_2), all parameters returned to baseline.

Conclusion: AAS induce left ventricular hypertrophy and impaired systolic and diastolic function in amateur strength athletes. The structural cardiac changes are positively associated with AAS dose and complete recovery occurred after AAS were discontinued.

Keywords: anabolic steroids, performance and image-enhancing drugs, strength athletes, bodybuilding, three-dimensional echocardiography

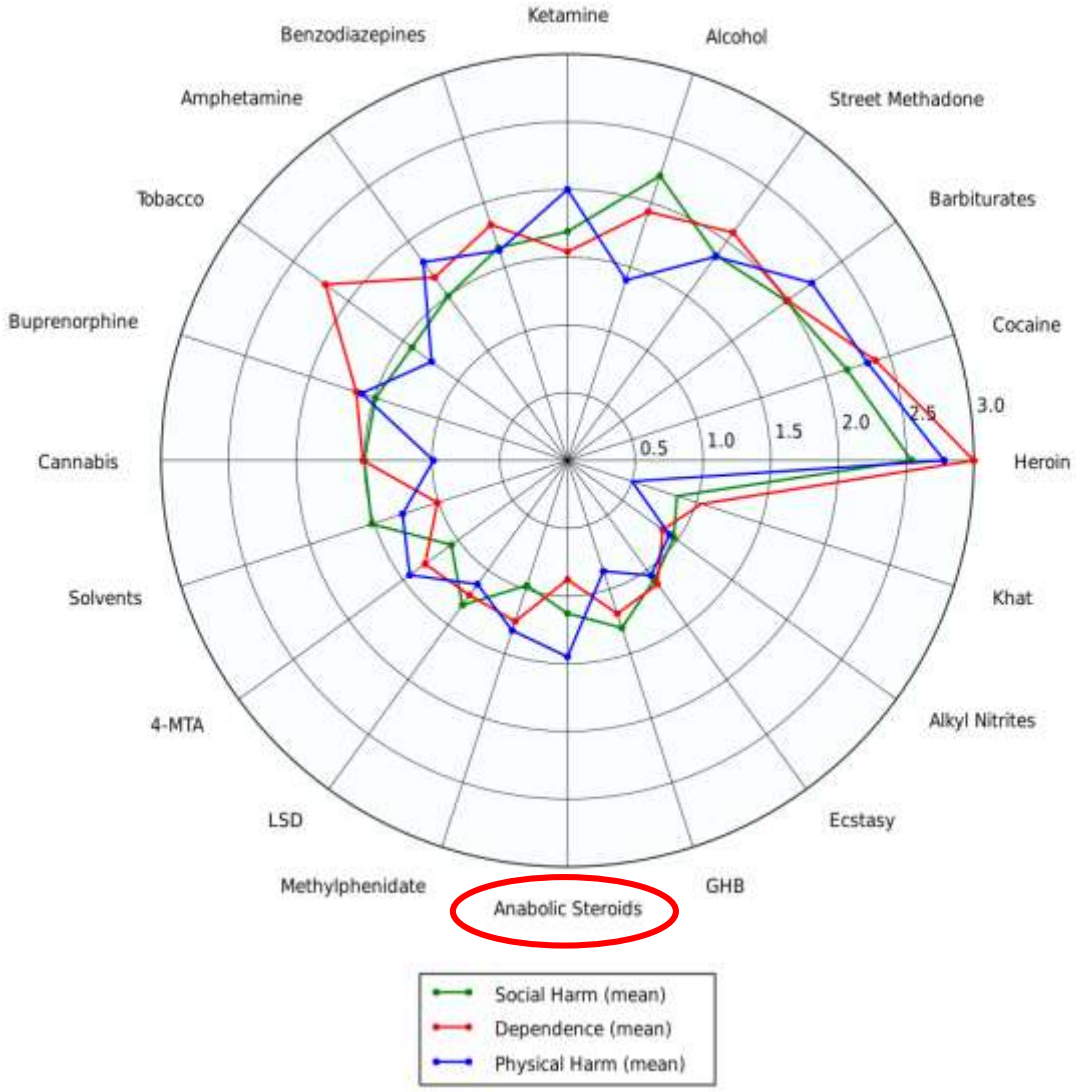
Smit D. Front Reprod Health 2021.

Mentale problemen

- Gemoeds- en gedragsproblemen
  - Gebruiker + omgeving
  - Drug effect vs. voorafbestaand lijden?

- Hypomanie
- Aggressie (23%)
- Vermoeidheid (16%)
- Depressie
- Slaapstoornissen

- Afhankelijkheid



Nutt D et al. Development of a rational scale to assess the harm of drugs of potential misuse. Lancet 2007.

Stigmata

- Kliniek
  - Androgeen deficiëntie symptomen
  - Infertiliteit / subfertiliteit
  - Muscullariteit, gynaecomastie, **truncale acne**

- Labo
  - Onderdrukt LH / FSH (dd. hypothalaam / hypofysair probleem: puberteit, fertiliteit, seksuele functie bevragen)
  - Laag SHBG
  - Testosteron afhankelijk van product
  - Hematocriet hoog bij actief gebruik
  - AMH, inhibine

Herstel

- Belangrijkste determinant = **tijd** sinds laatste toediening
  - Herstel van endogene testosteronproductie na ten vroegste 3 maanden
  - Herstel van spermatogenese kan ≥ 1 jaar duren

- Medische therapie niet aangewezen
  - Indien toch vb. bij uitgesproken afhankelijkheid: geen overdosering + snelle afbouw (weken/maanden)
  - Anti-oestrogenen of HCG: geen bewezen nut

- Psychologische opvolging

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