



**Os efeitos do uso exacerbado de EAA são reversíveis?**

# Redução da massa muscular e VO<sub>2</sub>max

Cessação por 8 semanas

TABLE 1. Description of subjects (M ± SD).

	Nonusers (N = 13)	Users Off (N = 11)	Users On (N = 11)
Age (yr)	26.5 ± 5.8	26.5 ± 5.6	26.5 ± 5.6
Weight (kg)	89.0 ± 12.2	92.7 ± 9.0	95.5 ± 9.0
BSA (m <sup>2</sup> )	2.08 ± 0.2	2.08 ± 0.2	2.12 ± 0.2
Body fat (%)	17.5 ± 6.3	15.3 ± 4.5	14.9 ± 4.4
Lean body mass (kg)	72.9 ± 6.3	78.3 ± 6.1 <sup>a</sup>	81.1 ± 6.9 <sup>a</sup>
VO <sub>2max</sub> (ml · kg <sup>-1</sup> · min <sup>-1</sup> )	50.2 ± 6.4	41.0 ± 4.5 <sup>a</sup>	41.0 ± 5.7 <sup>a</sup>

<sup>a</sup> Significantly different than nonusers ( $P < 0.05$ ).

BSA: body surface area; VO<sub>2max</sub>: maximum oxygen uptake.

# Redução da força muscular

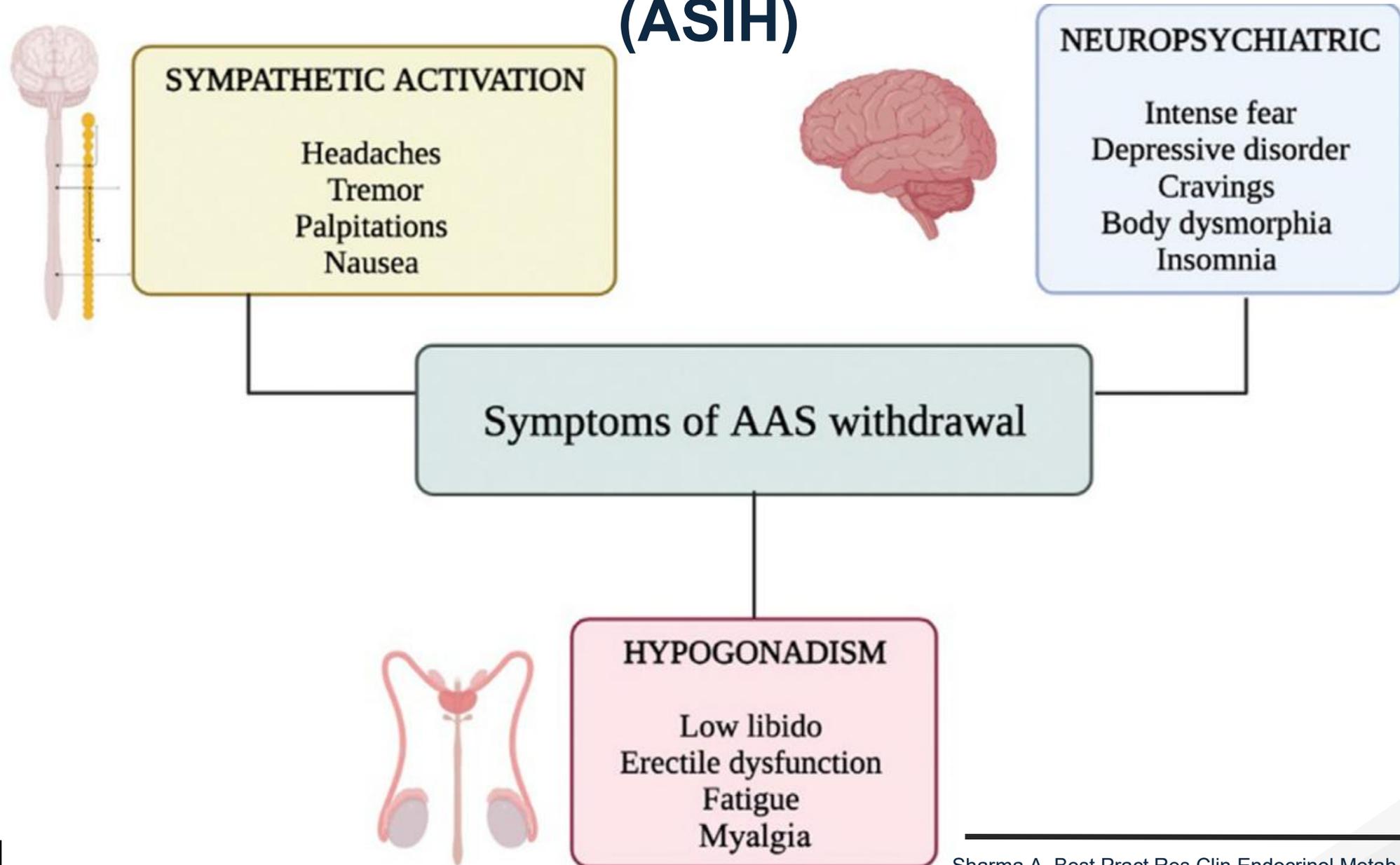
TABLE 5. Training history (M  $\pm$  SD).

	Nonusers (N = 13)	Users Off (N = 11)	Users On (N = 11)
Number of weight-training sessions $\cdot$ wk <sup>-1</sup>	4.1 $\pm$ 0.9	5.0 $\pm$ 0.9	6.5 $\pm$ 1.9
Duration of sessions (min $\cdot$ d <sup>-1</sup> )	90.0 $\pm$ 23.0	102.3 $\pm$ 29.1	100.0 $\pm$ 39.0
Repetitions/set	9.4 $\pm$ 2.1	10.0 $\pm$ 1.2	11.1 $\pm$ 2.1
Sets $\cdot$ d <sup>-1</sup>	4.7 $\pm$ 2.4	6.4 $\pm$ 2.4	5.5 $\pm$ 0.9
Heavy sessions $\cdot$ wk <sup>-1</sup>	2.3 $\pm$ 1.0	2.7 $\pm$ 1.1	3.6 $\pm$ 1.9
Aerobic sessions $\cdot$ wk <sup>-1</sup>	1.4 $\pm$ 0.8	3.5 $\pm$ 1.7	2.9 $\pm$ 2.2
Aerobic sessions (min $\cdot$ session <sup>-1</sup> )	44.5 $\pm$ 28.1	25.3 $\pm$ 13.8	30.6 $\pm$ 19.7
Bench press 1 RM (kg)	142.5 $\pm$ 29.2	160.2 $\pm$ 23.3 <sup>a</sup>	171.9 $\pm$ 26.9 <sup>b</sup>
Squat 1 RM (kg)	207.2 $\pm$ 56.4	189.8 $\pm$ 36.9	212.2 $\pm$ 46.0 <sup>p</sup>

<sup>a</sup> Significantly different from nonusers ( $P < 0.05$ ).

<sup>b</sup> Significantly different from users off ( $P < 0.05$ ).

# Anabolic androgenic steroid-induced hypogonadism (ASIH)



# Recuperação do eixo HPT

**Table 1. Demographic characteristics and anabolic androgenic steroids (AAS) abuse in the three groups.**

Variable	Control group	Current AAS abusers	Former AAS abusers	p-value
<i>Anabolic androgenic steroids abuse</i>				
Accumulated duration of AAS abuse (weeks)	-	142.3 (99.7–203.1)	111.8 (81.3–153.7)	0.32
AAS abuse during elapsed period (years)	-	5.7 (4.5–7.2)	6.3 (4.5–8.8)	0.46
Elapsed duration since AAS cessation (years)	-	-	2.5 (1.7–3.7)	-
Number of AAS compounds used (n) •		8 (4–9)	6 (4–9)	0.32
<i>Post-cycle therapy</i>	-			
Regularly used hCG (%)	-	48.7	57.6	0.46
Regularly used aromatase inhibitors /antioestrogen (%)	-	48.7	33.3	0.19

**100% = não usaram dentro de 6 meses**

**15% = usaram entre 6-12 meses**

# Recuperação do eixo HPT

Cessação de até 2,5 anos

Table 2. Reproductive hormone levels in the three groups.

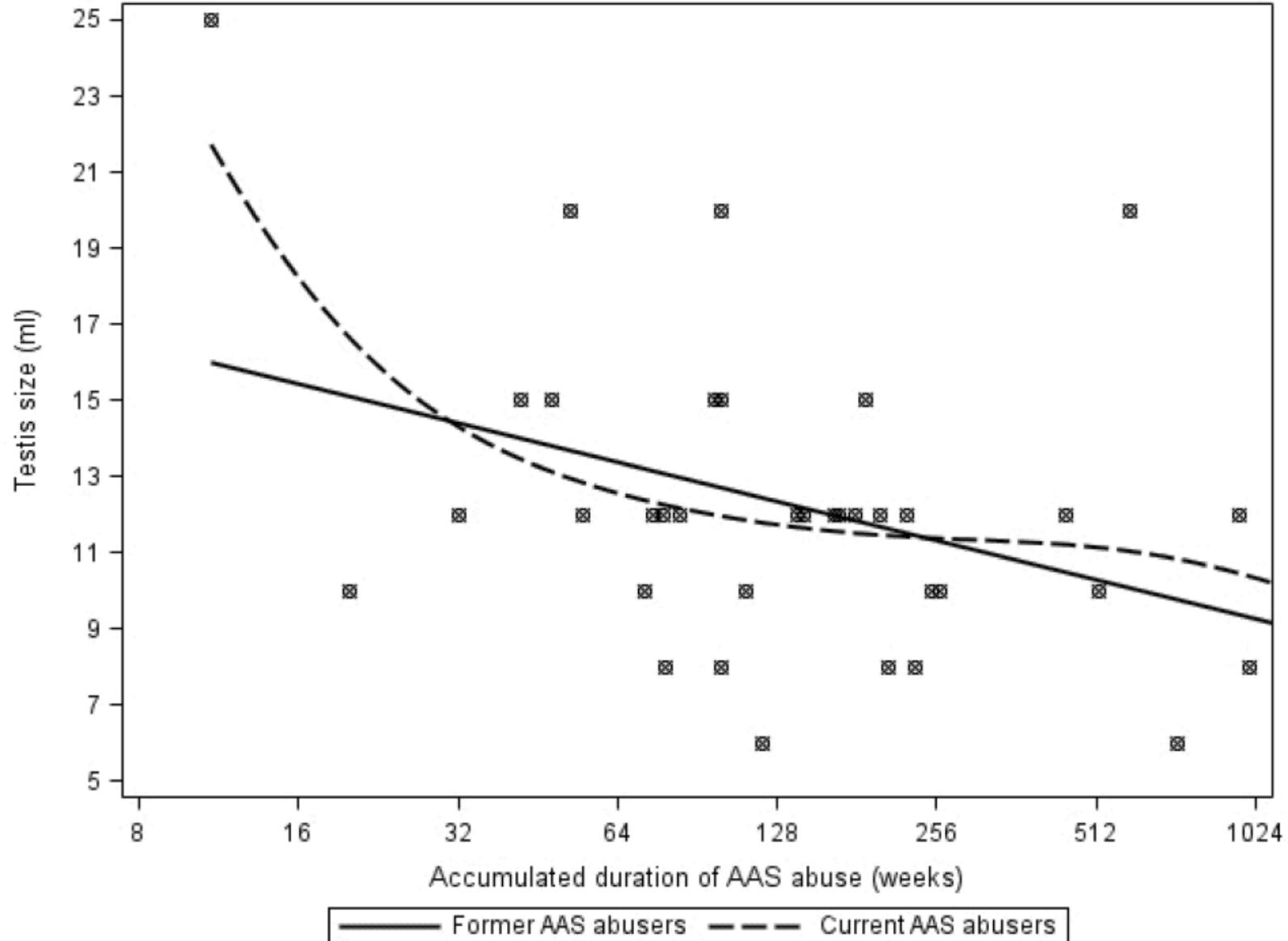
Variable	Control group n = 30	Current AAS abusers n = 37	Former AAS abusers n = 33	p-value
Testicular size (ml) ¶	22.3 (0.6) <b>b</b>	12.2 (0.7)	17.4 (0.8)	< 0.01
P-total testosterone (nmol/l)	18.8 (16.6–22.0) <b>b</b>	98.3 (47.4–122.7)	14.4 (11.9–17.7)	< 0.01
P-free testosterone (pmol/l)	480 (420–530) <b>b</b>	3780 (1870–5500)	410 (320–480)	< 0.01
P-androstendione (nmol/l) •	2.53 (2.27–2.82)	6.92 (5.41–8.84) <b>a</b>	2.33 (2.06–2.63)	< 0.01
P-DHEAS (nmol/l) ¶	4805 (391)	4929 (490)	4348 (302)	0.55
P-SHBG (nmol/l) •	33.3 (29.1–38.1)	8.4 (6.3–11.1) <b>a</b>	26.2 (20.7–33.1)	< 0.01
P-17 hydroxyprogesterone (nmol/l) •	2.88 (2.49–3.33)	0.14 (0.10–0.18) <b>a</b>	2.42 (1.86–3.15)	< 0.01
P-FSH (U/l)	4.2 (3.2–5.7)	0.3 (0.1–0.4) <b>a</b>	4.4 (3.3–6.2)	< 0.01
P-LH (U/l)	3.1 (2.5–3.9)	<0.1 (<0.1–0.1) <b>a</b>	3.6 (2.2–4.3)	< 0.01
S-inhibin B (pg/ml) ¶	175 (9)	81 (8) <b>a</b>	170 (11)	< 0.01
S-AMH (pmol/l) •	49.5 (41.6–59.0)	21.6 (16.3–28.7) <b>a</b>	44.7 (37.2–53.7)	< 0.01

FSH = 1,5 – 12,4 IU/L

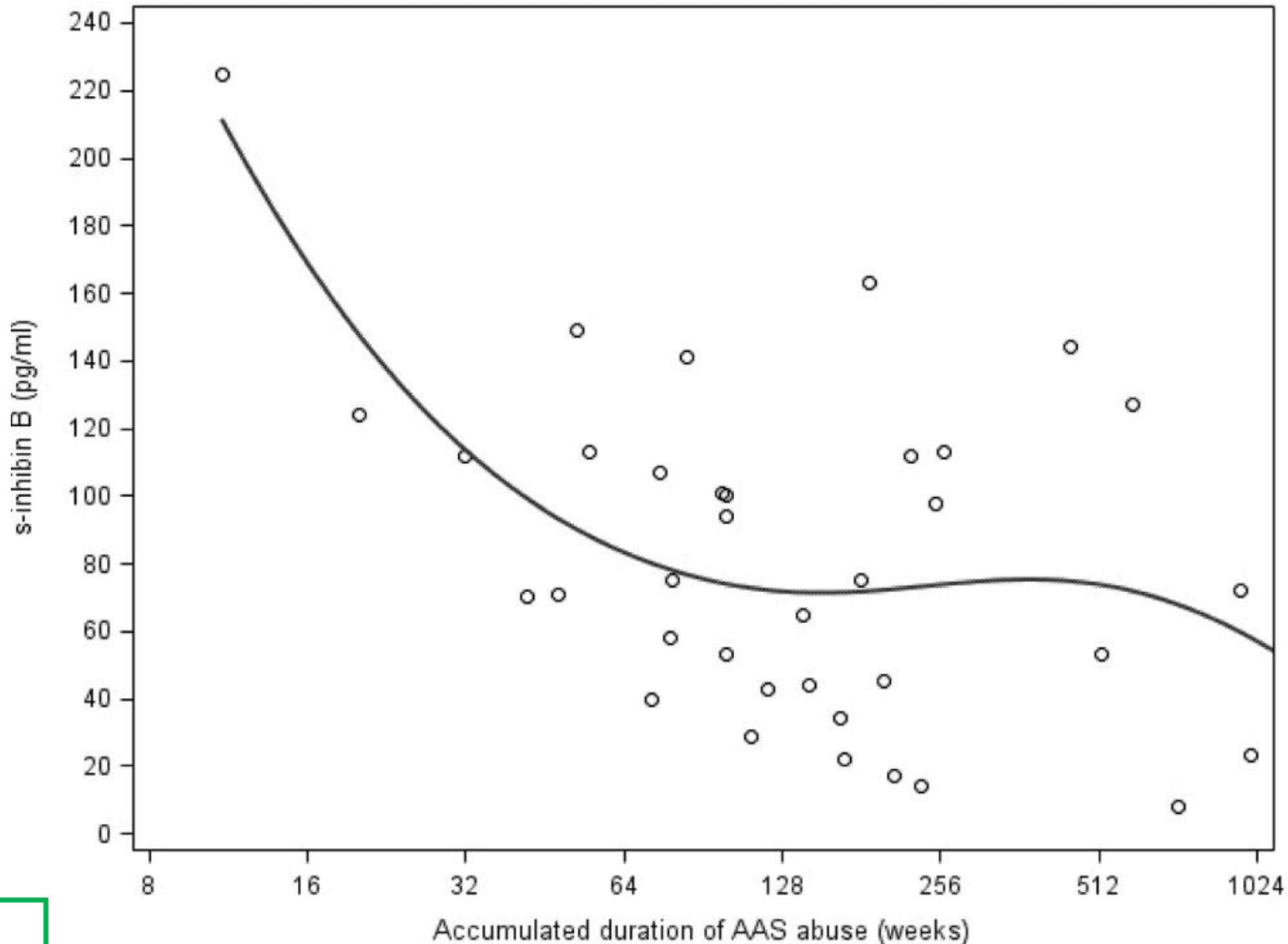
LH = 1,7 – 8,6 IU/L

27% ainda estava com T abaixo do normal

# Atrofia testicular



# Prejuízo da função testicular



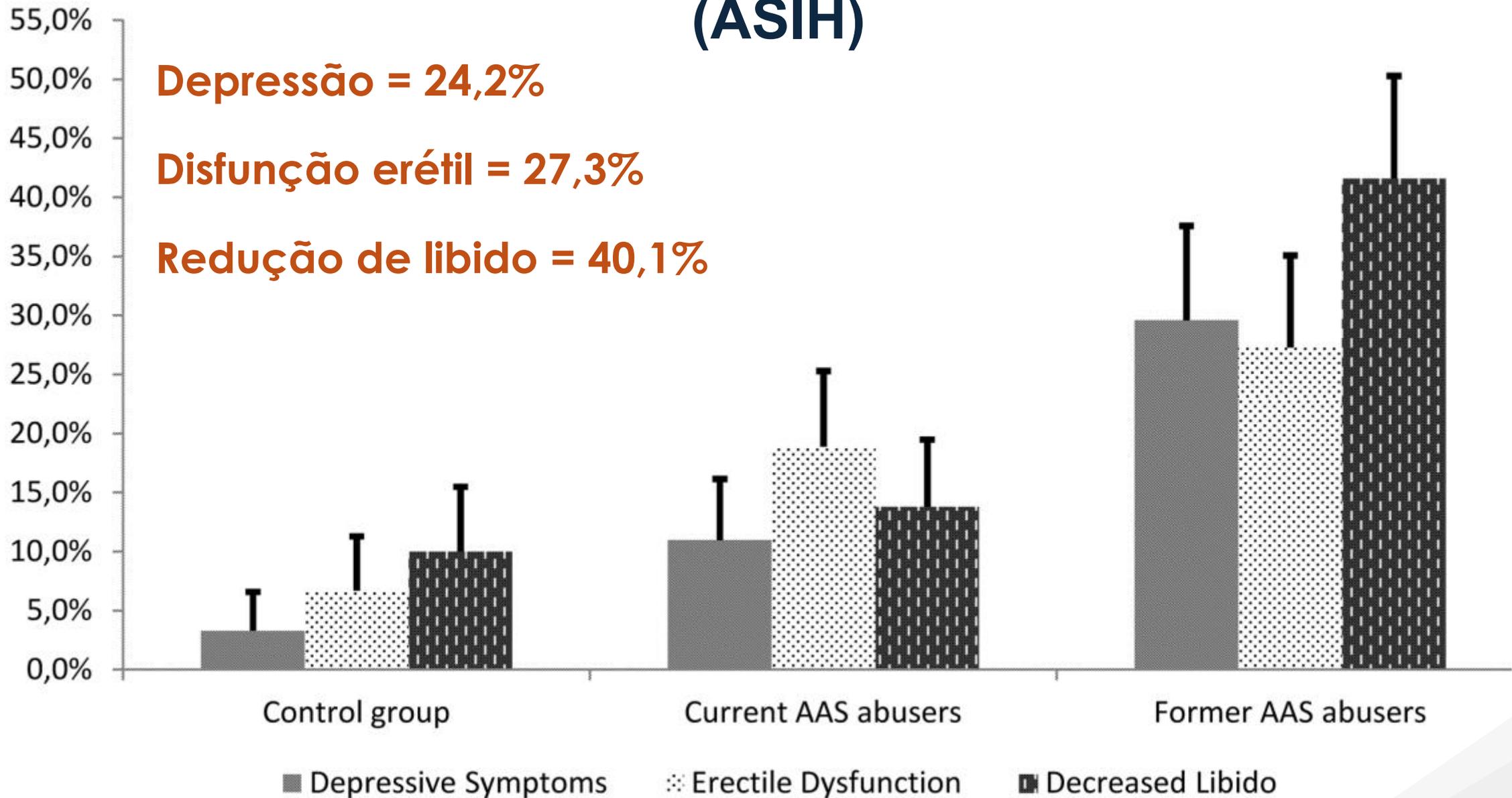
**Pior qualidade de vida (SF-36)  
Ex-EAA 58,9 vs. EAA 69,2**

# Redução do volume testicular

Cessação de 3-26 meses

Attribute <sup>a</sup>	Former AAS users	AAS Non-users	Estimated Difference	<i>p</i> <sup>b</sup>
	N = 19	N = 36	(95% confidence interval)	
Total testosterone level, ng/dL	319 (163)	449 (153)	131 (25, 227)	0.009
Range of total testosterone levels:				
Testosterone < 200 ng/dl, N (%)	5 (26)	1 (3)		0.011
Testosterone 200 – 348 ng/dl, N (%) <sup>c</sup>	5 (26)	7 (19)		
Testosterone > 348 ng/dl, N (%) <sup>c</sup>	9 (47)	28 (78)		
Free testosterone, pg/mL <sup>d</sup>	107 (51)	132 (49)	29 (-2, 61)	0.065
Luteinizing hormone, mIU/mL	3.9 (2.5)	4.6 (2.1)	0.9 (-0.5, 2.2)	0.19
Follicle-stimulating hormone, mIU/mL	4.7 (4.6)	5.2 (4.1)	0.9 (-1.6, 3.5)	0.46
Testicular volume, ml	19.9 (4.0)	22.2 (3.4)	2.3 (0.1, 4.5)	0.042

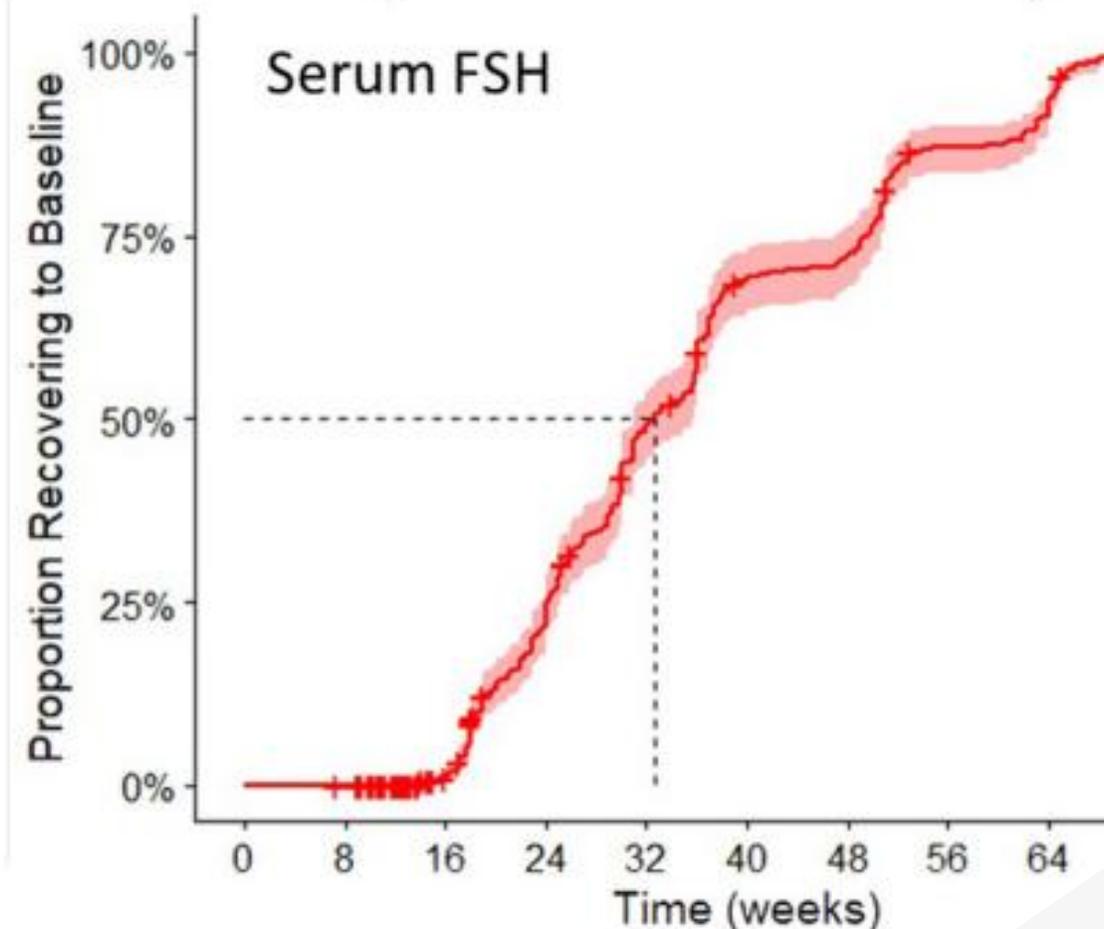
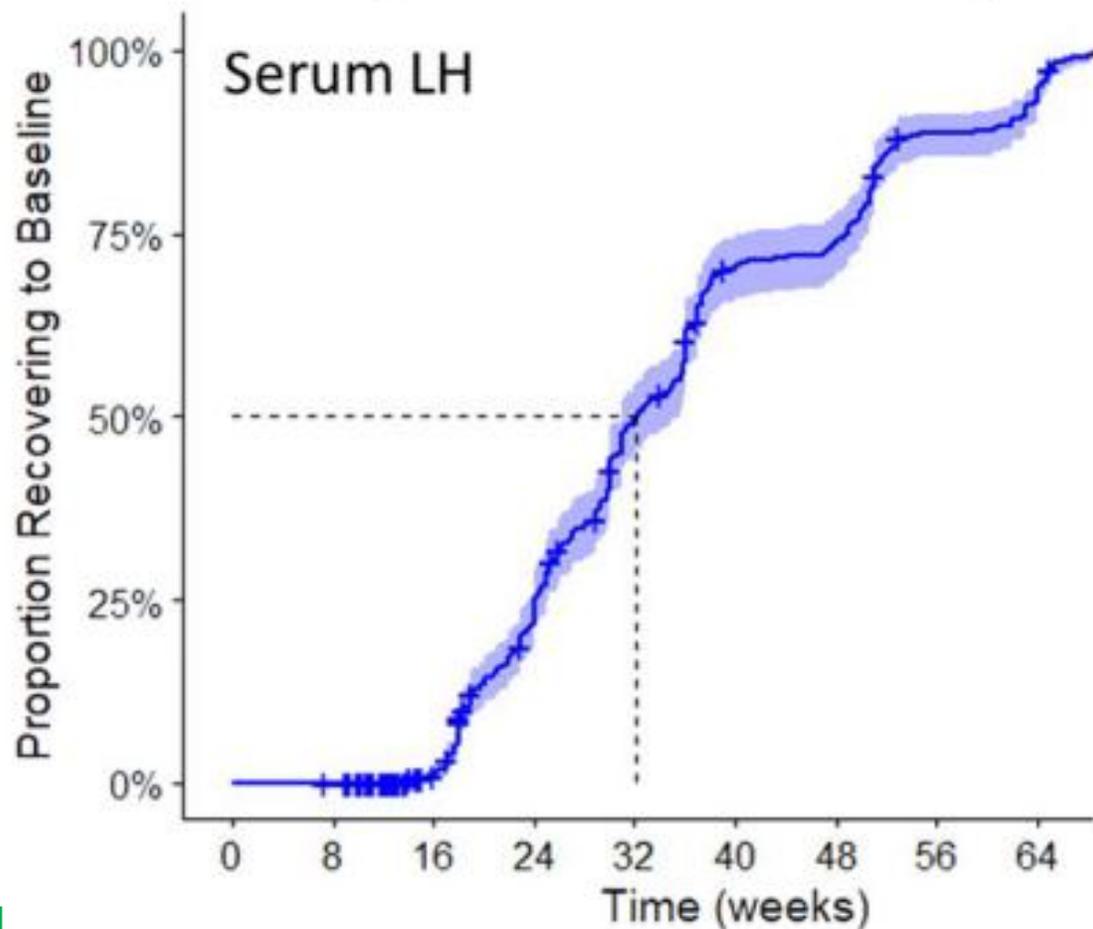
# Anabolic androgenic steroid-induced hypogonadism (ASIH)



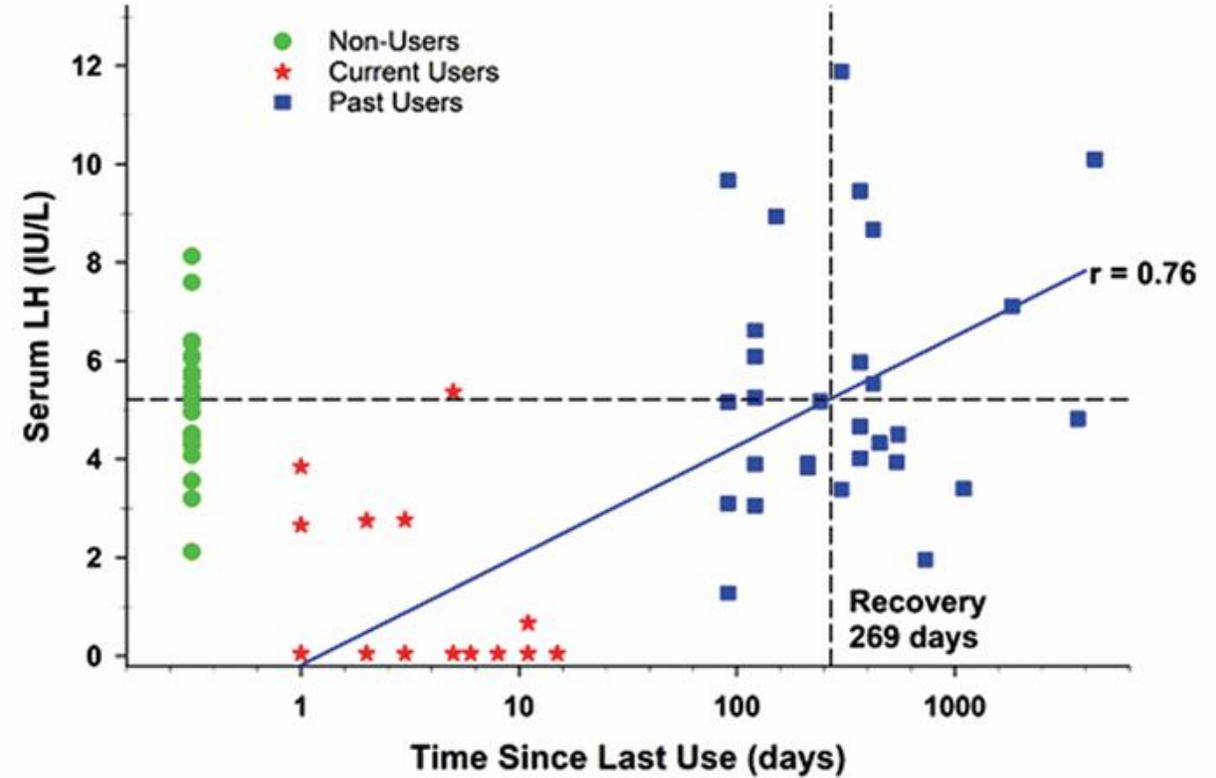
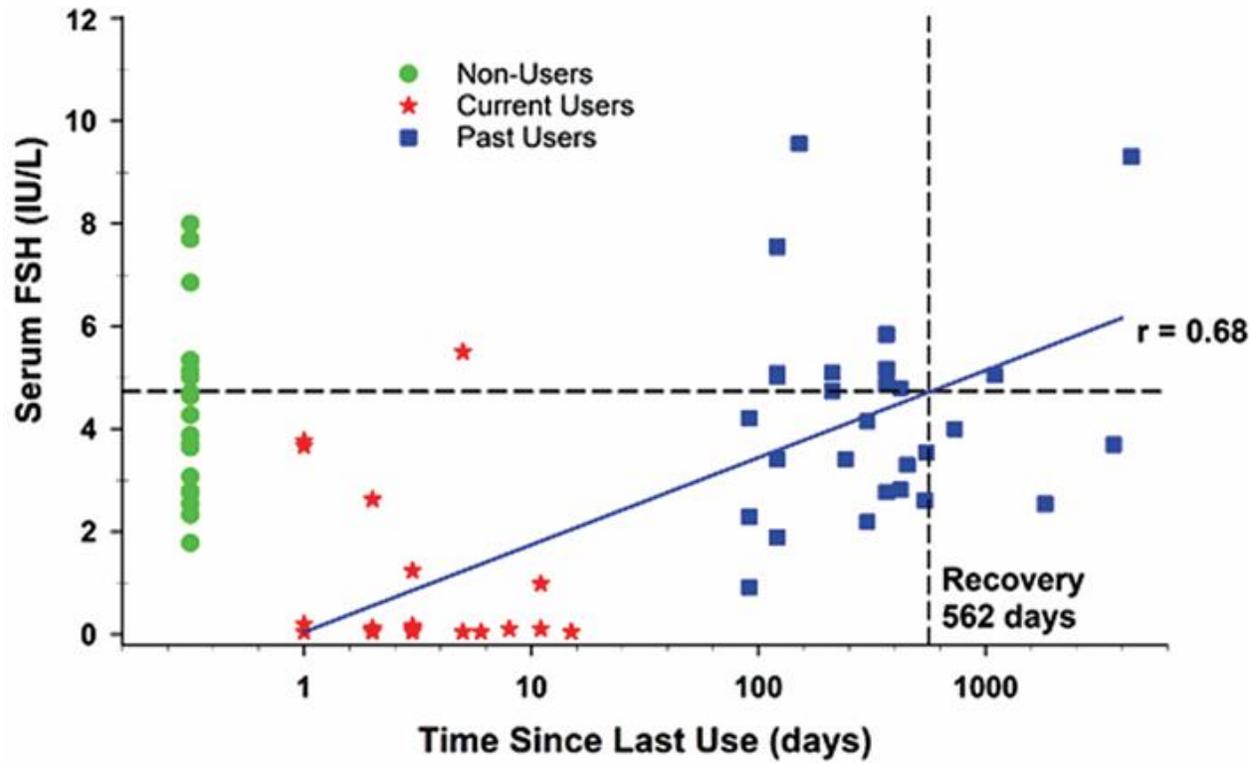
# Recuperação completa do eixo HPT

Após o uso por 2 anos

Recovery to Baseline: based on Return to Own Baseline



# Recuperação completa do eixo HPT



# Tempo médio de recuperação do eixo

**Table 5. Rate of recovery for fully reversible androgen suppressed functions**

Variable	Non-users <sup>a</sup>	Mean time to recovery (months)
Sperm output (million)	189	14.1
Sperm concentration (million/mL)	54.4	10.4
Sperm motility (%)	60	37.6
Serum LH (IU/L)	5.2	10.7
Serum FSH (IU/L)	4.9	19.6
Serum AMH (ng/mL)	7.1	7.3
Serum inhibin B (pg/mL)	173	31.7
Serum inhibin total (pg/mL)	97	56.2
Fat-free mass (kg)	66	26
Serum HDL cholesterol (mM)	1.2	51
Basal cholesterol efflux	0.99	10.3
ABCA-1 specific cholesterol efflux	0.59	5.7

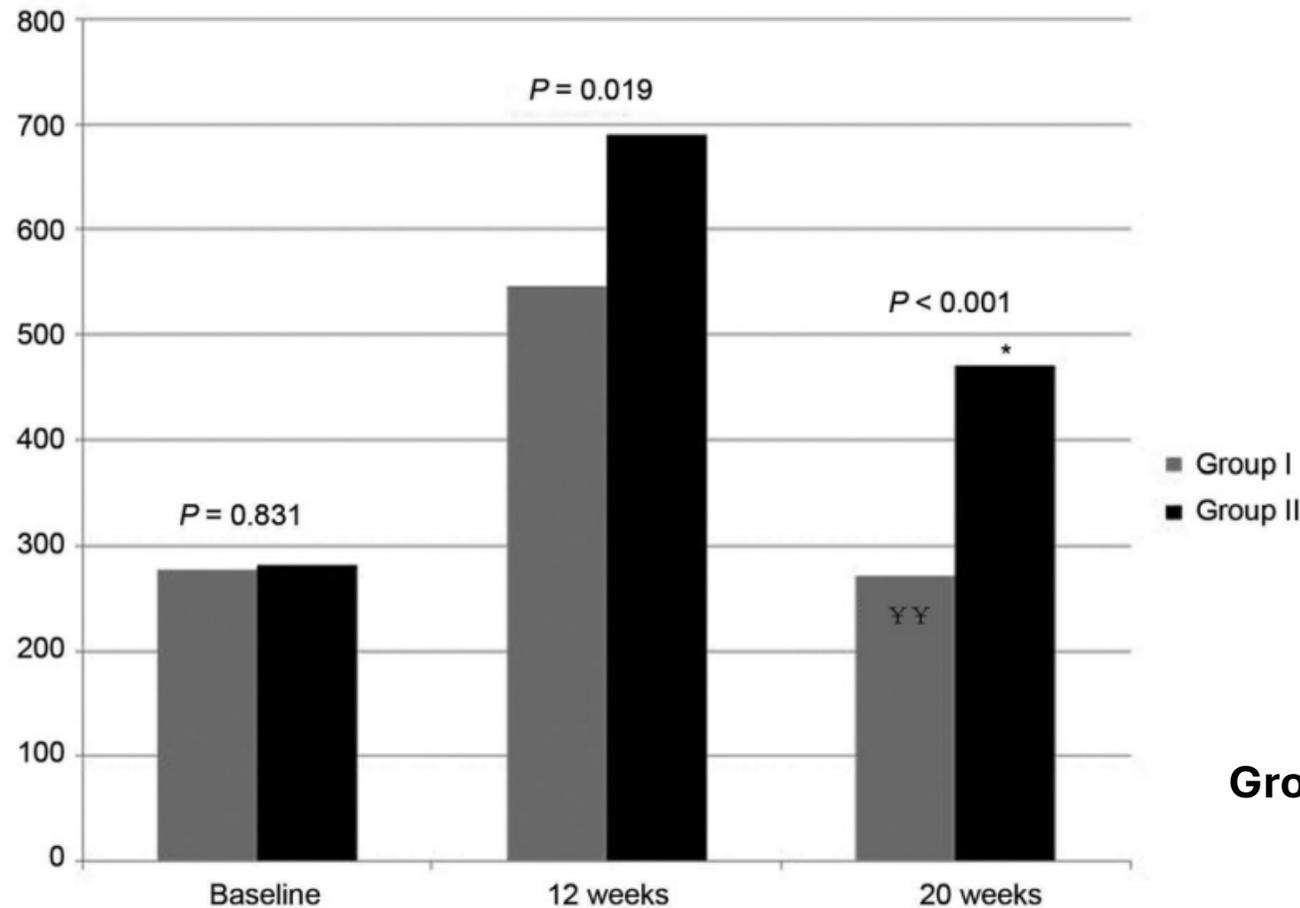
**Recuperação média**

**6-12 meses**

**Table 4. Reproductive function**

Variable	Current users	Past users	Non-users controls	<i>p</i> <sup>a</sup>	<i>p</i> <sup>b</sup>	<i>p</i> <sup>c</sup>
<i>n</i>	41	31	21			
History of infertility	8	0	0	.009	.009	
Acne	18	5	0	.02	<.001	
Gynecomastia	12	7	0		.005	
Temporal hair loss	13	10	2			
Testicular volume (mL)	14 ± 2	19 ± 2	28 ± 2			.004
Semen volume (mL)	3.0 ± 0.2	3.4 ± 0.3	3.7 ± 0.3			
Sperm output (million/ejaculate) <sup>#</sup>	4 (0, 39)	210 (80, 359)	203 (92, 340)	<.001	<.001	
Motility (%)	29 ± 4	50 ± 4	57 ± 5	<.001	<.001	
Serum LH (IU/L)	0.5 ± 0.3	5.5 ± 0.3	5.2 ± 0.4	<.001	<.001	
Serum FSH (IU/L)	0.5 ± 0.3	4.7 ± 0.4	4.9 ± 0.4	<.001	<.001	
Serum SHBG (IU/L)	17 ± 2	34 ± 2	42 ± 3	<.001	<.001	
Serum testosterone (ng/mL)	36.5 ± 3.3	6.2 ± 3.8	8.7 ± 4.6	<.001	<.001	
Serum DHT (ng/mL)	1.5 ± 0.1	0.5 ± 0.1	0.7 ± 0.2	<.001	<.001	
Serum estradiol (pg/mL)	146 ± 17	41 ± 19	48 ± 23	<.001	<.001	
Serum estrone (pg/mL)	65 ± 5	32 ± 6	38 ± 8	<.001	.005	
Serum DHEA (ng/mL)	4.8 ± 0.5	6.6 ± 0.6	7.2 ± 0.7	.024	.008	
Serum 3α-androstenediol (ng/mL)	2.2 ± 0.2	0.4 ± 0.2	0.6 ± 0.3	<.001	<.001	
Serum 3β-androstenediol (ng/mL)	0.35 ± 0.03	0.16 ± 0.04	0.11 ± 0.06	<.001	<.001	
Serum AMH (pg/mL)	3862 ± 621	7562 ± 599	7052 ± 728	<.001	<.001	
Serum inhibin B (pg/mL)	97 ± 9	160 ± 10	173 ± 56	<.001	<.001	
Serum total inhibin (pg/mL)	45 ± 4	85 ± 5	97 ± 6	<.001	<.001	
Serum activin B (pg/mL)	88 ± 12	97 ± 14	76 ± 16			

# Melhora manutenção de TT com exercício combinado

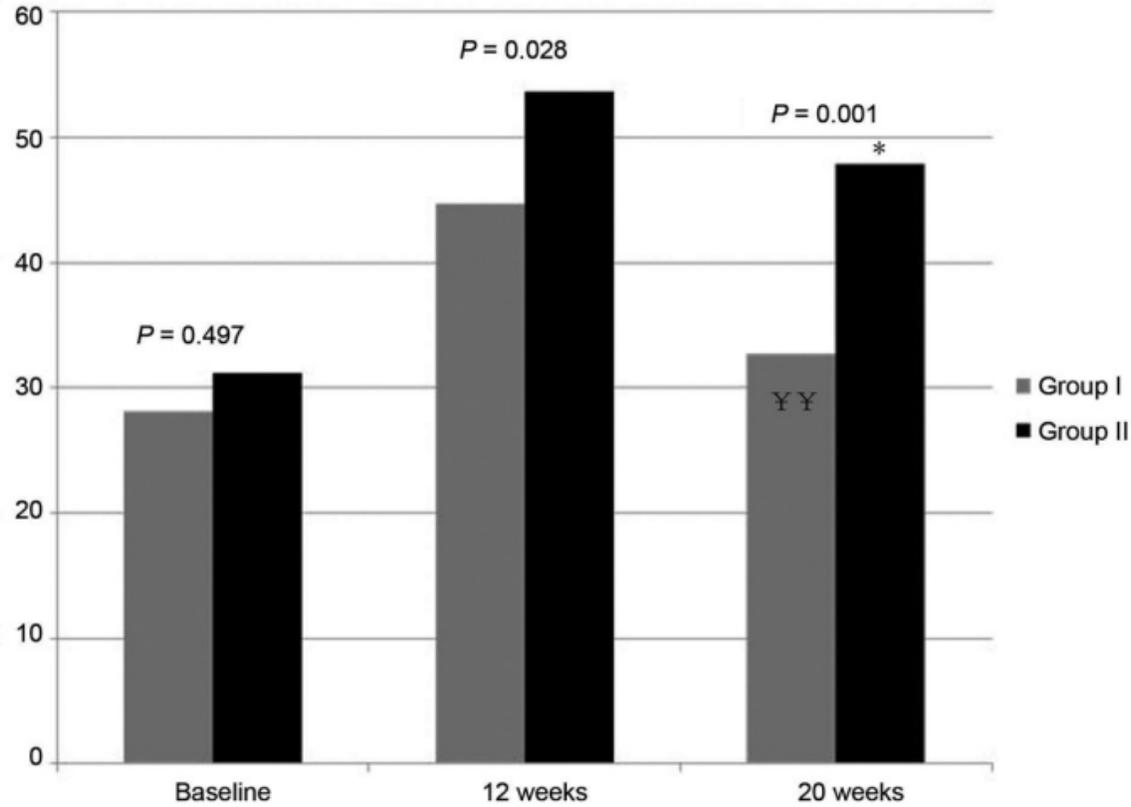


2% testosterone gel (50 mg)

Group II with exercise

**Figure 1:** Changes of serum total testosterone levels and comparison between two groups ( $P$  value by independent  $t$ -test,  $P = 0.019$  at 12 weeks,  $P < 0.001$  at 20 weeks).  $^{**}P < 0.001$  by paired  $t$ -test compared to 3 months in Group I,  $^{*}P < 0.01$  by paired  $t$ -test compared to 3 months in Group II.

# Melhora manutenção de função sexual com exercício combinado



International Index of Erectile Function (IIEF)

**15 perguntas**

Função erétil

Orgasmo

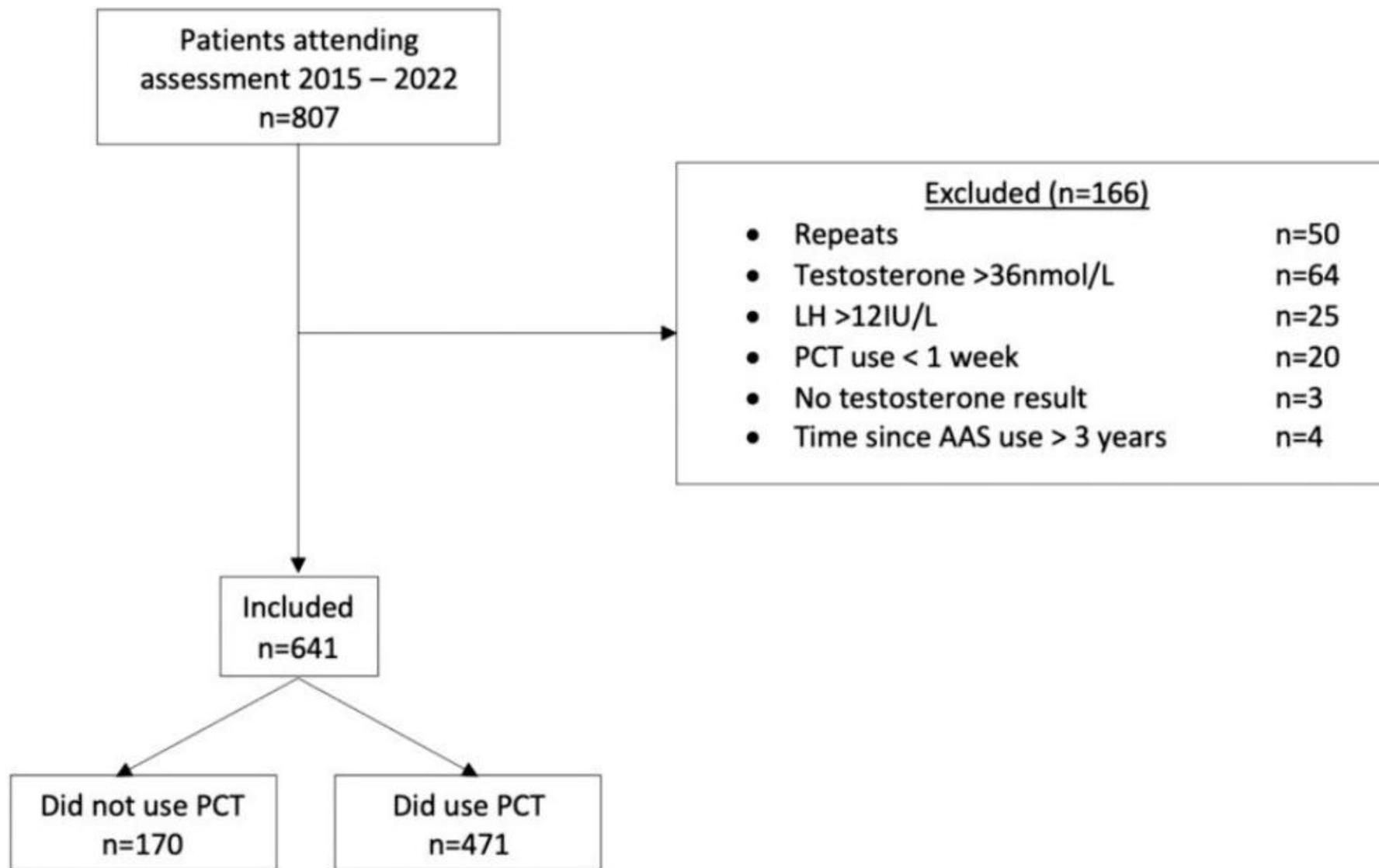
Desejo sexual

Satisfação na relação sexual

Satisfação geral

**Figure 2:** Changes of total score of IIEF and comparison between two groups ( $P$  value by independent  $t$ -test,  $P = 0.028$  at 12 weeks,  $P = 0.001$  at 20 weeks).  $^{**}P < 0.001$  by paired  $t$ -test compared to 3 months in Group I,  $^{*}P < 0.01$  by paired  $t$ -test compared to 3 months in Group II.

# TPC é necessário para interromper o uso?



# TPC é necessário para interromper o uso?

Normalização do eixo HPT = 48,2% do usuários

**Table 1.** Baseline characteristics of men not using and using PCT.

	No-PCT <i>n</i> = 170	PCT <i>n</i> = 471	<i>P</i> value
Age (Mean ± SD)	34.5 ± 9.4	32.8 ± 7.6	.07
AAS cycle duration (weeks) (Median (IQR))	12.0 (7.0-26.0)	13.0 (10.0-19.75)	.29
Time since last AAS use (weeks) (Median (IQR))	13.0 (5.0-30.0)	10.0 (8.0-17.0)	.11
Class of AAS ( <i>n</i> (%))			
Testosterone based only	50 (37)	120 (30.5)	.1668
DHT based only	13 (9.6)	9 (2.3)	<.001
19-Nortestosterone derivatives only	1 (0.7)	2 (0.5)	>.99
Testosterone based + DHT based	12 (8.9)	46 (11.7)	.4272
Testosterone based + 19-Nortestosterone	41 (30.4)	134 (34.1)	.4593
DHT + 19-Nortestosterone	1 (0.7)	1 (0.3)	.4464
Test + DHT + 19-Nortestosterone	17 (12.6)	81 (20.6)	.0404

# TPC é necessário para interromper o uso?

**Table 1.** Baseline characteristics of men not using and using PCT.

	No-PCT <i>n</i> = 170	PCT <i>n</i> = 471	<i>P</i> value
Type of AAS ( <i>n</i> (%))			
Testosterone	115 (86)	380 (96)	<.001
Trenbolone	38 (28)	151 (38)	.0472
Drostanolone	9 (7)	58 (15)	.0159
Boldenone	9 (7)	53 (13)	.0426
Nandrolone	24 (18)	88 (22)	.3281
Stanozolol	3 (2)	27 (7)	.0513
Methandienone	11 (8)	42 (11)	.5065
Mesterolone	0	12 (3)	.0430
Oxandrolone	29 (22)	54 (14)	.0386
Metenolone	1 (0.7)	10 (2)	0.3049
Oxymetholone	6 (4)	20 (5)	>.99
Drugs as PCT ( <i>n</i> (%))			
Tamoxifen	0	352 (75)	
Clomiphene	0	362 (77)	
Human chorionic gonadotrophin (hCG)	0	347 (74)	
Tamoxifen + Clomiphene + hCG	0	222 (47)	
Anastrozole	0	18 (4)	

# Clinician's guide to the management of azoospermia induced by exogenous testosterone or anabolic-androgenic steroids

Manaf Al Hashimi <sup>1 2</sup>, Gernar-Michael Pinggera <sup>1 3</sup>, Rupin Shah <sup>1 4</sup>, Ashok Agarwal <sup>1 5</sup>



# TPC é necessário para interromper o uso?

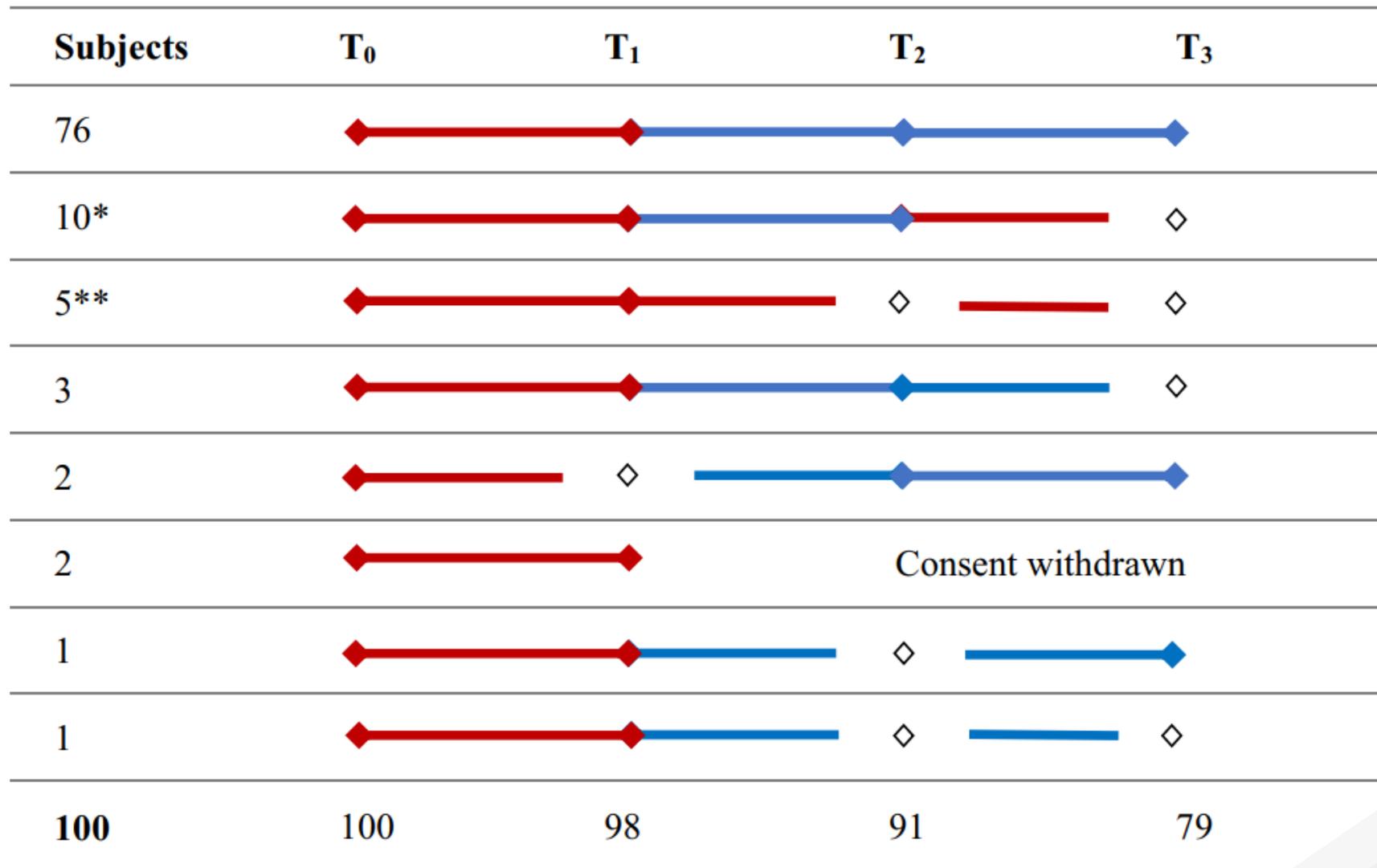
**Table 2.** Multivariable associations with normalization of reproductive hormones.

Variable	Subgroup	Category	Odds ratio (95% CI)	P value
Age <sup>a</sup>	—	—	0.93 (0.69, 1.24)	.60
Use of PCT	Last AAS use ≤3 months	No	1	.001
		Yes	3.80 (1.78, 8.10)	
	Last AAS use >3 months	No	1	.99
		Yes	1.01 (0.47, 2.17)	
Number of AAS	—	1	1	.009
		2	0.55 (0.31, 0.98)	
		3	0.46 (0.24, 0.88)	
		4+	0.25 (0.11, 0.58)	
		AAS cycle duration	—	
		3-6 months	0.76 (0.46, 1.25)	
		>6 months	0.34 (0.17, 0.70)	
Time since last AAS use	No PCT use	≤3 months	1	<.001
		>3 months	5.68 (2.26, 14.2)	
	PCT use	≤3 months	1	.13
		>3 months	1.50 (0.88, 10.9)	

# Estudo Haarlem



T1 = Fim do ciclo  
 T2 = após 3 meses  
 T3 = após 1 ano



# Hemoglobina e hematócrito

**TABLE 2** Results of blood analysis comprising blood cell count and lipid parameters during clinic visits. The conversion factor for haemoglobin from mmol/l to g/l is 0.6206

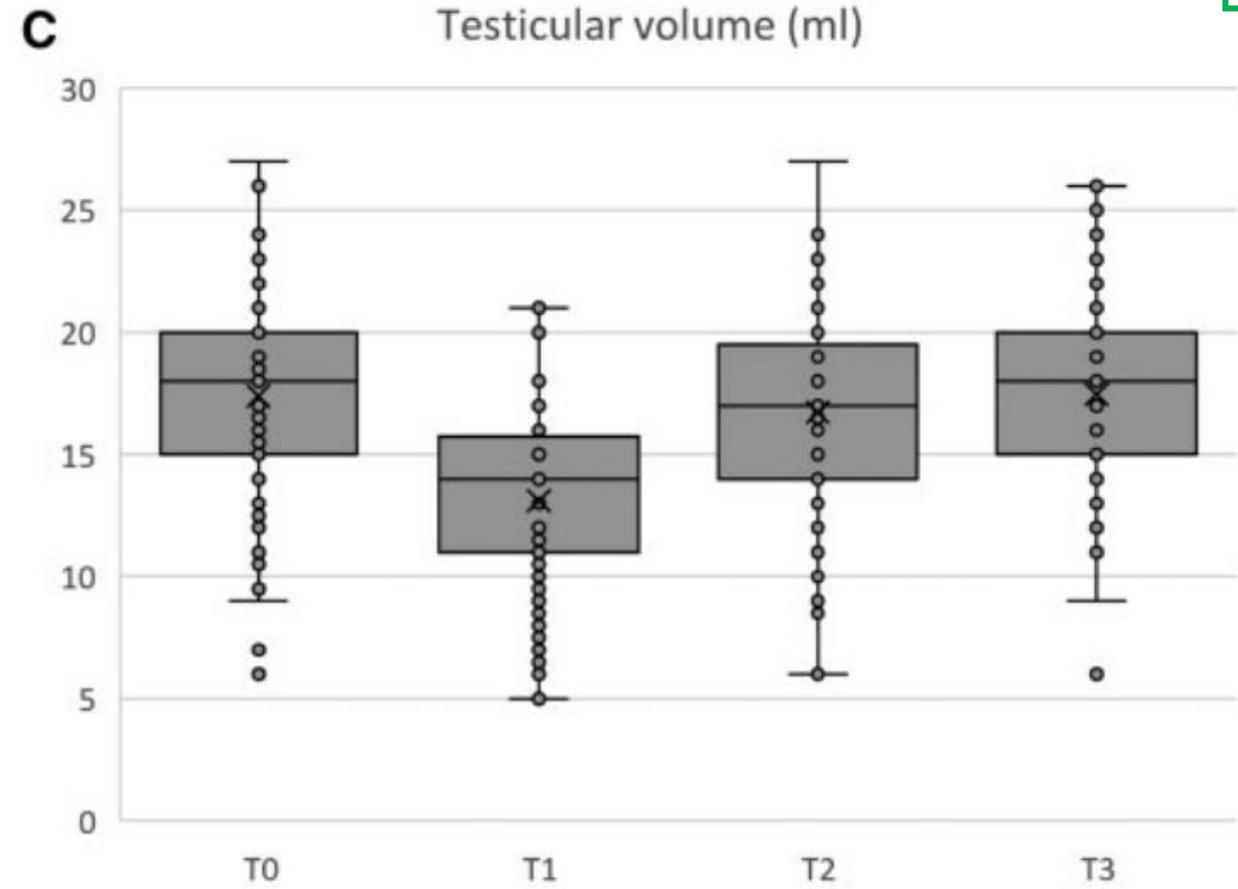
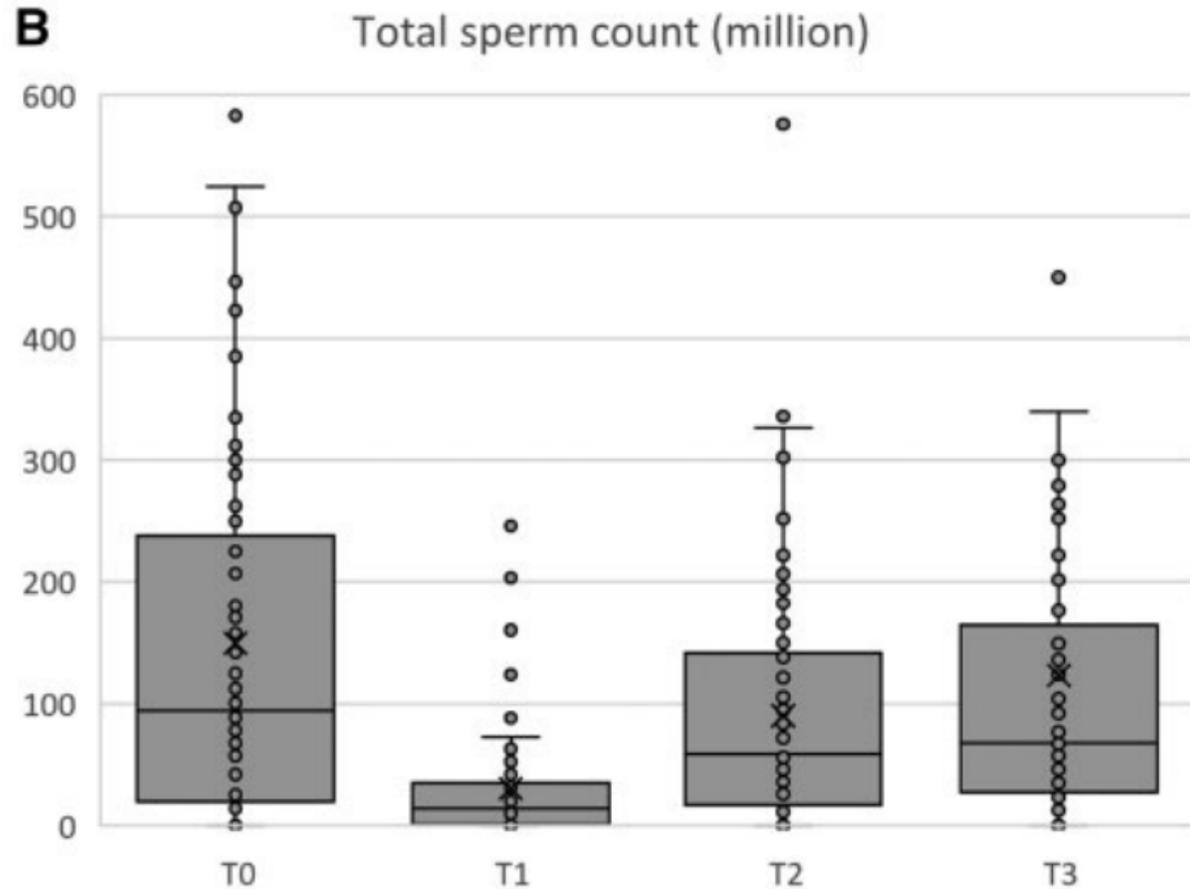
Blood analysis (unit, RR)	T0 (n = 100)		T1 (n = 98)		T2 (n = 90)		T3 (n = 79)	
	$\bar{x}$	[95% CI]	$\bar{x}$	[95% CI]	$\bar{x}$	[95% CI]	$\bar{x}$	[95% CI]
	n	(%)	n	(%)	n	(%)	n	(%)
Haemoglobin (mmol/L, 8.5–11.0)	9.8	[9.7–10.0]	10.2 <sup>‡</sup>	[10.0–10.3]	9.8	[9.7–9.9]	9.7	[9.7–9.9]
	3	(3%)	11 <sup>‡</sup>	(11%)	2	(2%)	3	(4%)
Haematocrit (L/L, 0.40–0.50)	0.46	[0.45–0.46]	0.49 <sup>‡</sup>	[0.48–0.49]	0.46	[0.45–0.47]	0.45	[0.45–0.46]
	5	(5%)	32 <sup>‡</sup>	(33%)	2	(2%)	2	(3%)
Platelet count ( $\times 10^9/L$ , 150–400)	223	[212–234]	270 <sup>‡</sup>	[259–280]	221	[210–232]	219	[213–236]
	0	(0%)	5	(5%)	7	(8%)	3	(4%)
White blood cells ( $\times 10^9/L$ , 4.0–10.0)	6.0	[5.6–6.4]	7.8	[7.4–8.2]	6.0	[5.7–6.5]	5.8	[5.5–6.3]
	2	(2%)	16	(16%)	5	(6%)	1	(1%)

# Recuperação do perfil lipídico

Blood analysis (unit, RR)	T0 (n = 100)		T1 (n = 98)		T2 (n = 90)		T3 (n = 79)	
	$\bar{x}$	[95% CI]	$\bar{x}$	[95% CI]	$\bar{x}$	[95% CI]	$\bar{x}$	[95% CI]
	n	(%)	n	(%)	n	(%)	n	(%)
Cholesterol total (mmol/L, 1.5–6.5)	4.4	[4.2–4.6]	4.3	[4.1–4.5]	4.2	[4.0–4.4]	4.4	[4.1–4.6]
	2	(2%)	5	(5%)	0	(0%)	1	(1%)
LDL cholesterol (mmol/L, 1.5–4.5)	2.9	[2.7–3.1]	3.3 <sup>†</sup>	[3.1–3.6]	2.8	[2.5–3.0]	2.8	[2.6–3.1]
	12	(12%)	23 <sup>†</sup>	(23%)	10	(11%)	9	(11%)
HDL cholesterol (mmol/L, 0.9–1.7)	1.2	[1.1–1.2]	0.8 <sup>†</sup>	[0.7–0.8]	1.1	[1.1–1.2]	1.2	[1.1–1.3]
	14	(14%)	58 <sup>†</sup>	(59%)	10	(11%)	8	(10%)
Triglycerides (mmol/L, 0.6–2.2)	1.0	[0.8–1.1]	1.2 <sup>†</sup>	[1.0–1.3]	1.1	[0.9–1.2]	1.1	[1.0–1.3]
	22	(22%)	21	(22%)	18	(20%)	19	(24%)

**HDL e LDL não normalizaram em 10% dos usuários após 1 ano**

# Recuperação do sistema reprodutor (azoospermia)



Total de espermatozoide < **40 milhões em 34%** dos usuários após 1 ano (**77%** durante EAA)

# Estrutura miocárdica

TABLE 3. Myocardial structure and function (M  $\pm$  SD).

	Nonusers (N = 13)	Users Off (N = 11)	Users On (N = 11)
LVID (mm)	55.7 $\pm$ 4.3	57.5 $\pm$ 3.3	59.1 $\pm$ 3.5 <sup>a</sup>
IVS (mm)	9.3 $\pm$ 1.2	10.3 $\pm$ 1.2	11.1 $\pm$ 1.2 <sup>a,b</sup>
LVPW (mm)	9.5 $\pm$ 1.6	10.2 $\pm$ 1.0	11.2 $\pm$ 1.5 <sup>a</sup>
LV mass (g)	168.5 $\pm$ 36.2	182.8 $\pm$ 26.9	210.6 $\pm$ 42.6 <sup>a,b</sup>
Shortening fraction	0.37 $\pm$ 0.04	0.37 $\pm$ 0.04	0.35 $\pm$ 0.06

<sup>a</sup> Significantly different than nonusers ( $P < 0.05$ ).

<sup>b</sup> Significantly different than users off ( $P < 0.05$ ).

LVID: left ventricular internal diameter in diastole; IVS: interventricular septal thickness in diastole; LVPW: left ventricular posterior wall thickness in diastole; LV mass: left ventricular mass.

# Rate and Extent of Recovery from Reproductive and Cardiac Dysfunction Due to Androgen Abuse in Men

Discontinuation 3 months

**Table 1. Descriptive features of the 3 groups**

Variable	Current users	Past users	Non-users	<i>P</i> <sup>a</sup>	<i>P</i> <sup>b</sup>	<i>P</i> <sup>c</sup>
<i>n</i>	41	31	21			
Age at study (years)	34 ± 1	33 ± 2	32 ± 2			
Age at first use (years)	27 ± 1	23 ± 1	—	.014	—	—
Total use (weeks)	137 (72, 338)	115 (48, 168)	—			
Height (cm)	179 ± 1	176 ± 1	180 ± 1			
Weight (kg)	95.3 ± 2.3	87.0 ± 2.6	83.8 ± 3.2	.013	.004	
Body mass index (cm/kg <sup>2</sup> )	29.5 ± 0.6	28.0 ± 0.7	25.9 ± 0.9		.001	
Body surface area (m <sup>2</sup> )	2.19 ± 0.03	2.07 ± 0.03	2.05 ± 0.04	.008	.010	
Heart rate (beats/min)	75 ± 2	67 ± 2	66 ± 3	.009	.016	
Systolic blood pressure (mm)	130 ± 3	121 ± 3	120 ± 4	.031	.041	
Diastolic blood pressure (mm)	77 ± 1	73 ± 1	70 ± 2	.037	.006	
Fat mass (kg)	15.7 ± 1.2	19.8 ± 1.5	17.6 ± 1.7			
Lean mass (kg)	75.6 ± 1.7	64.8 ± 2.0	63.1 ± 2.3	<.001	<.001	
Bone mass (kg)	3.4 ± 0.4	4.0 ± 0.5	3.2 ± 0.6			
Hip BMD (gm/cm <sup>2</sup> )	1.18 ± 0.02	1.13 ± 0.03	1.14 ± 0.03			
Hip z score	0.32 ± 0.31	0.24 ± 0.37	0.36 ± 0.44			
Spine BMD (gm/cm <sup>2</sup> )	1.34 ± 0.03	1.27 ± 0.03	1.31 ± 0.04			
Spine z score	0.51 ± 0.26	0.22 ± 0.31	0.44 ± 0.36			

**Tempo de uso = 2,4 anos**

# Adaptações miocárdicas

**Table 3** Echocardiographic data on the left ventricle

	Ex-users (n = 15)	Users (n = 17)	Weightlifters (n = 15)
LVMM (g)	232 ± 42	281 (54)*	204 (44)‡‡‡
LVMM per unit BSA (g/m <sup>2</sup> )	112 (17)	132 (23)*	93 (12)‡‡‡
LVMM per unit FFM (g/kg)	3.16 (0.53)	3.32 (0.48)	2.43 (0.26)‡‡‡‡‡
EDD (mm)	54.0 (5.0)	56.5 (3.5)	54.0 (4.0)
EDD per unit BSA (mm/m <sup>2</sup> )	26.0 (2.0)	26.5 (2.0)	25.0 (2.0)‡
EDD per unit FFM (mm/kg)	0.74 (0.08)	0.67 (0.05)*	0.66 (0.08)‡‡
ESD (mm)	35.0 (4.5)	38.5 (2.5)*	36.0 (3.5)
IVS (mm)	11.5 (1.2)	12.3 (1.4)	10.3 (1.0)‡‡‡‡
IVS per unit BSA (mm/m <sup>2</sup> )	5.6 (0.6)	5.8 (0.7)	4.7 (0.5)‡‡‡‡
IVS per unit FFM (mm/kg)	0.16 (0.02)	0.15 (0.02)	0.13 (0.02)‡‡‡‡
LVPW (mm)	10.2 (0.8)	11.4 (1.3)*	9.4 (1.5)‡‡‡
LVPW per unit BSA (mm/m <sup>2</sup> )	5.0 (0.5)	5.4 (0.6)	4.3 (0.5)‡‡‡‡
LVPW per unit FFM (mm/kg)	0.14 (0.02)	0.14 (0.01)	0.11 (0.02)‡‡‡‡‡

Values are mean (SD).

Users v ex-users: \*p<0.05.

Ex-users v weightlifters: †p<0.05; ††p<0.01; †††p<0.001.

Users v weightlifters: ‡p<0.05; ‡‡‡p<0.001.

BSA, body surface area; EDD, end diastolic internal diameter; ESD, end systolic internal diameter; FFM, fat-free body mass; IVS, interventricular septum; LVMM, left ventricular muscle mass; LVPW, left ventricular posterior wall.

# Recuperação estrutural e funcional do coração

Variable	Current users	Past users	Non-users	<i>p</i> <sup>a</sup>	<i>p</i> <sup>b</sup>	<i>p</i> <sup>c</sup>
<i>n</i>	41	31	21			
<b>Structure</b>						
Interventricular septum (mm)	10.7 ± 0.4	9.1 ± 0.4	8.7 ± 0.5	.007	.003	
Posterior wall thickness (mm)	10.6 ± 0.3	9.3 ± 0.4	8.9 ± 0.5			
LV EDD (mm)	52.3 ± 0.8	51.9 ± 1.0	49.3 ± 1.2			
LV ESD (mm)	36.5 ± 1.3	36.2 ± 1.4	33.7 ± 1.7			
Left ventricular mass (g)	232 ± 10	190 ± 11	167 ± 14	.006	<.001	
LVM/BSA (g/m <sup>2</sup> )	106 ± 4	92 ± 4	81 ± 5	.016	<.001	
End diastolic volume (ml)	137.4 ± 4.1	134.4 ± 4.8	127.4 ± 5.7			
End systolic volume (ml)	60.0 ± 2.1	57.8 ± 2.4	52.9 ± 2.9			
Left atrial volume (ml)	61.6 ± 2.5	58.7 ± 3.0	53.2 ± 3.5			
Left atrial volume indexed (mL/m <sup>2</sup> )	29.1 ± 1.2	28.5 ± 1.4	26.4 ± 1.6			
Right ventricle basal diameter (mm)	38.3 ± 1.0	37.4 ± 1.1	38.0 ± 1.3			
Right ventricle mid diameter (mm)	27.72 ± 0.9	27.4 ± 1.0	29.2 ± 1.2			
Right ventricle length (mm)	74.1 ± 1.8	70.7 ± 2.1	70.4 ± 2.5			
<b>Systolic function</b>						
Left ventricular ejection fraction (%)	56.7 ± 0.5	57.3 ± 0.6	58.2 ± 0.74			
Global longitudinal strain (%)	-17.6 ± 0.4	-19.4 ± 0.5	-19.7 ± 0.5	.002	.001	
TAPSE (mm)	2.4 ± 0.1	2.4 ± 0.1	2.2 ± 0.1			

# Are the cardiac effects of anabolic steroid abuse in strength athletes reversible?

A Urhausen, T Albers, W Kindermann

Discontinuation for 43 months

Heart 2004;90:496–501. doi: 10.1136/hrt.2003.015719

## AAS score

To estimate the extent of AAS abuse, a point score was established. One to four points were given in each of the categories “years of administration” (2.5 to 4.0, 5.0 to 6.0, 6.5 to 10.0, and >10 years), “weeks of AAS use per year” (<20, 21 to 30, 31 to 37, and >38 weeks), and “weekly dosage in mg” (<500, 550 to 750, 800 to 1250, and >1250 mg). The limits were chosen in order to include 6–10 athletes in each of the categories; if other anabolic substances such as growth hormone and clenbuterol were used, an additional point was accorded. The maximum point score available was therefore **14 and the minimum 3.** The mean (SD) AAS score of users was not significantly higher than that of ex-users, at 9.2 (2.7) v 7.8 (3.2).

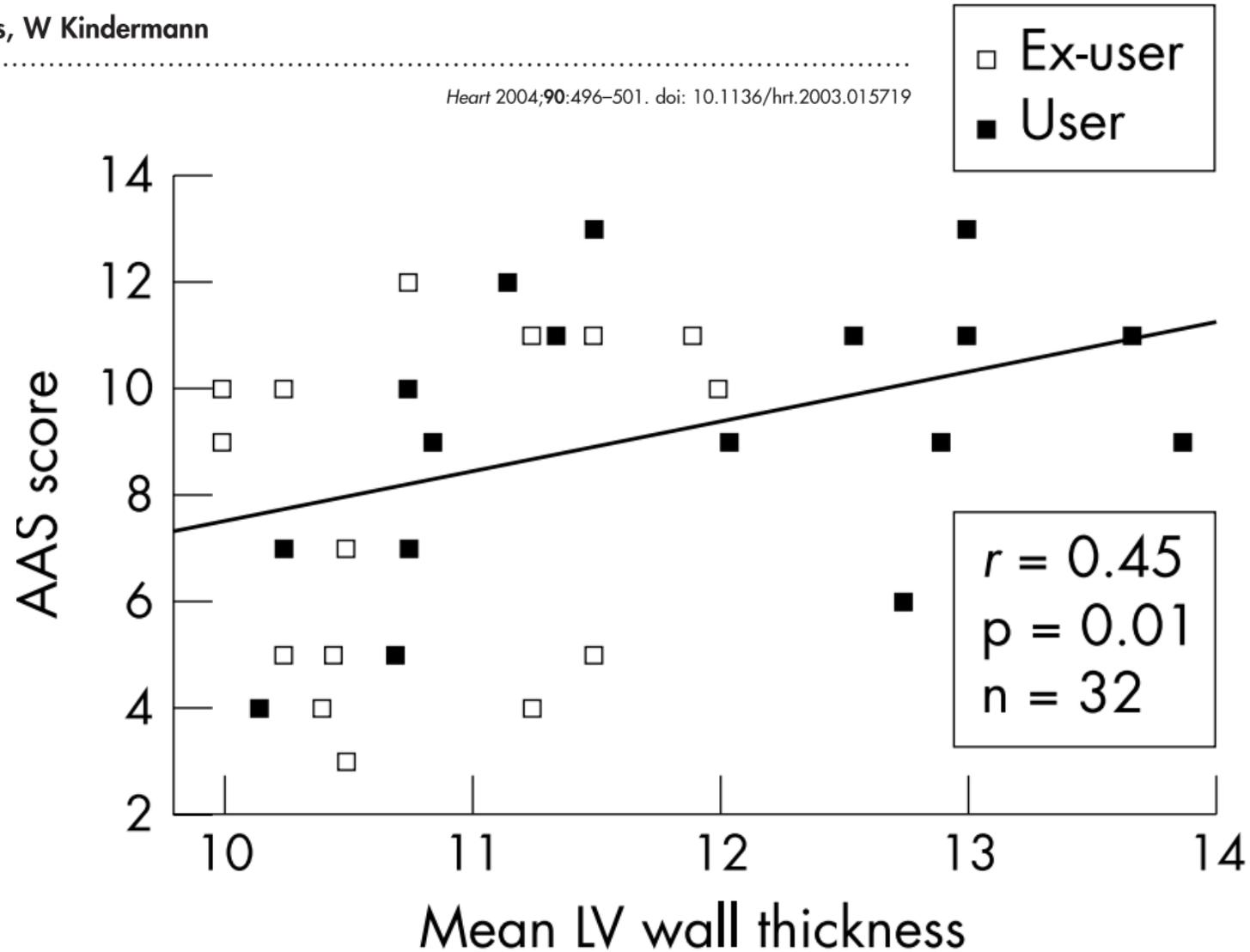
Users = 8 years

Ex-users = 9 years

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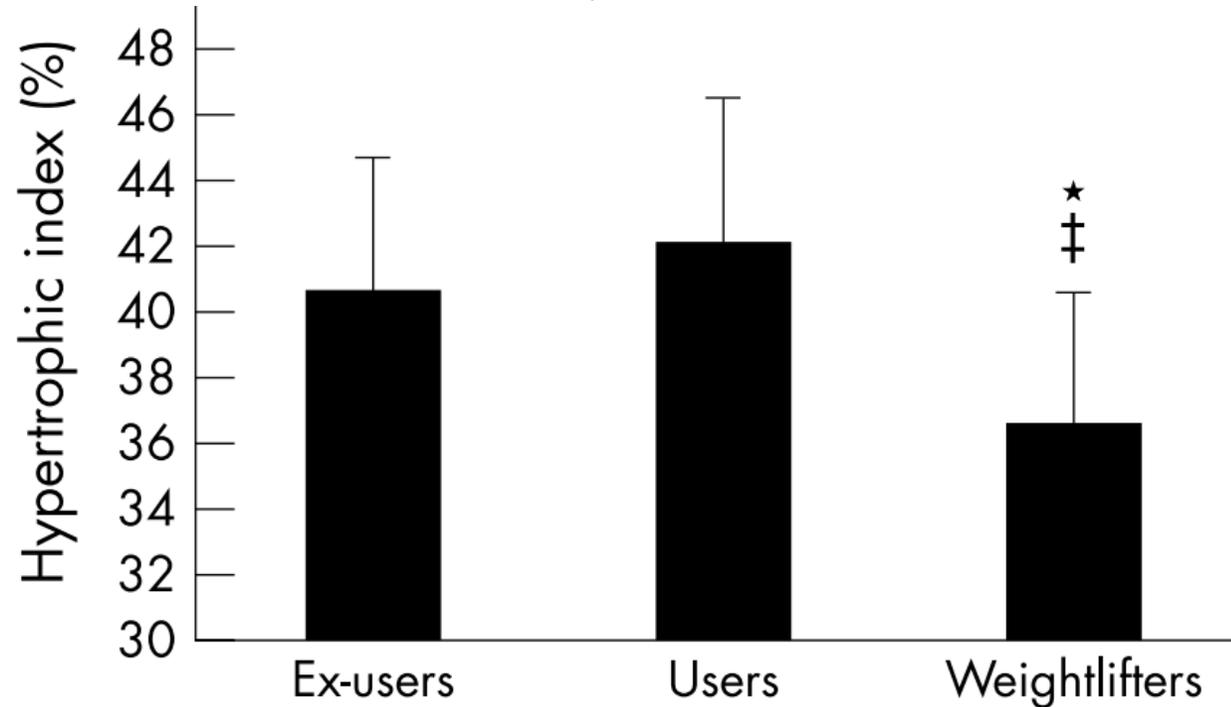
Heart 2004;90:496-501. doi: 10.1136/hrt.2003.015719



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**Figure 1** Hypertrophic index (interventricular septum plus left ventricular posterior wall thickness divided by internal diameter). Values are means, error bars = SD. Ex-users v weightlifters: \* $p < 0.05$ ; users v weightlifters: ‡ $p < 0.01$ .

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**Objective:** To investigate the reversibility of adverse cardiovascular effects after chronic abuse of anabolic androgenic steroids (AAS) in athletes.

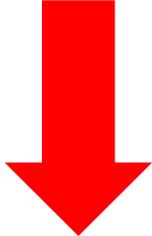
**Methods:** Doppler echocardiography and cycle ergometry including measurements of blood pressure at rest and during exercise were undertaken in 32 bodybuilders or powerlifters, including 15 athletes who had not been taking AAS for at least 12 months (ex-users) and 17 currently abusing AAS (users), as well as in 15 anabolic-free weightlifters.

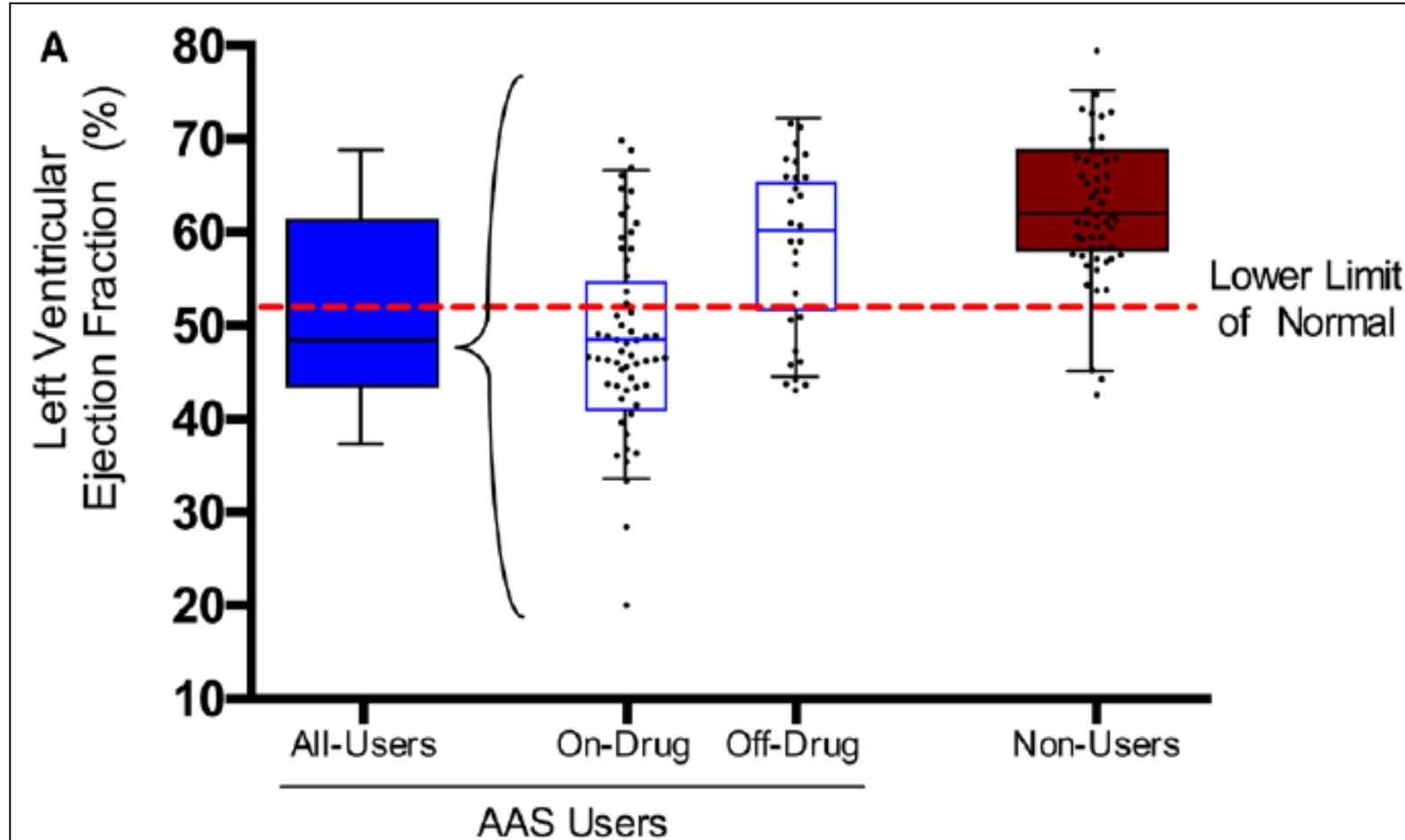
**Results:** Systolic blood pressure was higher in users (mean (SD) 140 (10) mm Hg) than in ex-users (130 (5) mm Hg) ( $p < 0.05$ ) or weightlifters (125 (10) mm Hg;  $p < 0.001$ ). Left ventricular muscle mass related to fat-free body mass and the ratio of mean left ventricular wall thickness to internal diameter were not significantly higher in users (3.32 (0.48) g/kg and 42.1 (4.4)%) than in ex-users (3.16 (0.53) g/kg and 40.3 (3.8)%), but were lower in weightlifters (2.43 (0.26) g/kg and 36.5 (4.0)%;  $p < 0.001$ ). Left ventricular wall thickness related to fat-free body mass was also lower in weightlifters, but did not differ between users and ex-users. Left ventricular wall thickness was correlated with a point score estimating AAS abuse in users ( $r = 0.49$ ,  $p < 0.05$ ). In all groups, systolic left ventricular function was within the normal range. The maximum late transmitral Doppler flow velocity (Amax) was higher in users (61 (12) cm/s) and ex-users (60 (12) cm/s) than in weightlifters (50 (9) cm/s;  $p < 0.05$  and  $p = 0.054$ ).

**Conclusions:** Several years after discontinuation of anabolic steroid abuse, strength athletes still show a slight concentric left ventricular hypertrophy in comparison with AAS-free strength athletes.



# Cardiovascular Toxicity of Illicit Anabolic-Androgenic Steroid Use

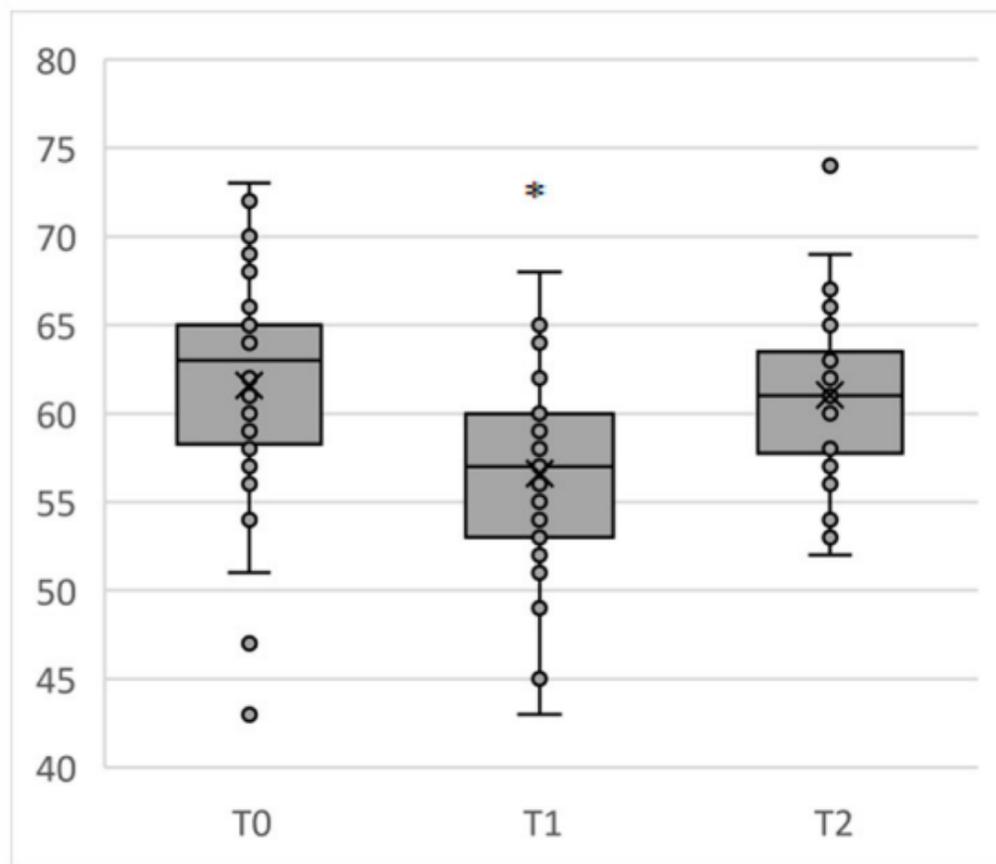
**FEVE**  
  
**5-10%**



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

Diederik L Smit<sup>1</sup>, A J Voogel<sup>2</sup>, Martin den Heijer<sup>3</sup>, Willem de Ronde<sup>1</sup>

**A** 3D LVEF (%)



**B** E/A-ratio

