

# Cardiovascular Effects of Long Term Androgenic Anabolic Steroid Use

Jordan Grosdidier, Zach Harrison, Ryan VanMoer  
Physician Assistant Department, Northwestern College

## Context

Androgenic Anabolic steroids (AAS) have been a consistent area of debate when it comes to athletes. Anabolic steroids are commonly used in certain sports like powerlifting and bodybuilding. Negative health effects have been found to be associated with the long-term use of anabolic steroids.

## Objective

The objective of this review is to determine if there are negative cardiovascular effects associated with chronic androgenic anabolic steroid use when compared to non-steroid users.

## Method

A literature review of past research articles was performed. The individuals used for this study were males between the ages of 18-54. Body builders were the most represented group of individuals as they have the highest likelihood of using anabolic steroids. In certain studies, these bodybuilders were compared to non-bodybuilders to ensure decreased cardiac function was not contributed to the bodybuilder lifestyle. Echocardiogram, transthoracic echocardiogram, left ventricular function test, blood pressure measurements, heart rate measurements, and MRI were all used to determine the cardiovascular function in selected individuals.<sup>1,2,3,4,5</sup>

## Results

- Consistent echocardiography results revealed increased increases in left ventricular mass with a decreased left ventricular function in anabolic steroid users. Compared with nonusers, AAS users demonstrated relatively reduced LV systolic function (mean±SD left ventricular ejection fraction = 52±11% versus 63±8%;  $P<0.001$ ) and diastolic function (early relaxation velocity = 9.3±2.4 cm/second versus 11.1±2.0 cm/second;  $P<0.001$ ). Users currently taking AAS at the time of evaluation (N=58) showed significantly reduced LV systolic (left ventricular ejection fraction = 49±10% versus 58±10%;  $P<0.001$ ) and diastolic function (early relaxation velocity = 8.9±2.4 cm/second versus 10.1±2.4 cm/second;  $P=0.035$ ) compared with users currently off-drug (N=28).<sup>1,2</sup>
- In addition, AAS users demonstrated higher coronary artery plaque volume than nonusers (median [interquartile range] 3 [0, 174] mL<sup>3</sup> versus 0 [0, 69] mL<sup>3</sup>;  $P=0.012$ ). Lifetime AAS dose was strongly associated with coronary atherosclerotic burden (increase [95% confidence interval] in rank of plaque volume for each 10-year increase in cumulative duration of AAS use: 0.60 SD units [0.16-1.03 SD units];  $P=0.008$ ).<sup>1,2</sup>
- AAS users had an increase in blood pressure compared to non-AAS users ( $p<0.5$ ) and sedentary controls ( $p<0.001$ ). AAS users also had an increase in sympathetic modulation when compared to non-AAS users ( $p<0.5$ ) and sedentary controls ( $p<0.001$ ) as well as a decrease in parasympathetic modulation compared to both non-AAS users and sedentary controls ( $p<0.5$ ).<sup>1,3</sup>
- HDL decreases from 70% to 39% and LDL increase from 11% to 100% within the first week of AAS use and normalized within 3-5 weeks after discontinuation.<sup>5</sup>

## Conclusion

Anabolic steroids can be contributed to decreased left ventricular function, increased blood pressure, atherosclerosis, and decreased HDL with increased LDL levels all leading to an overall decrease in cardiovascular function and increase in cardiovascular events.

## Graphs

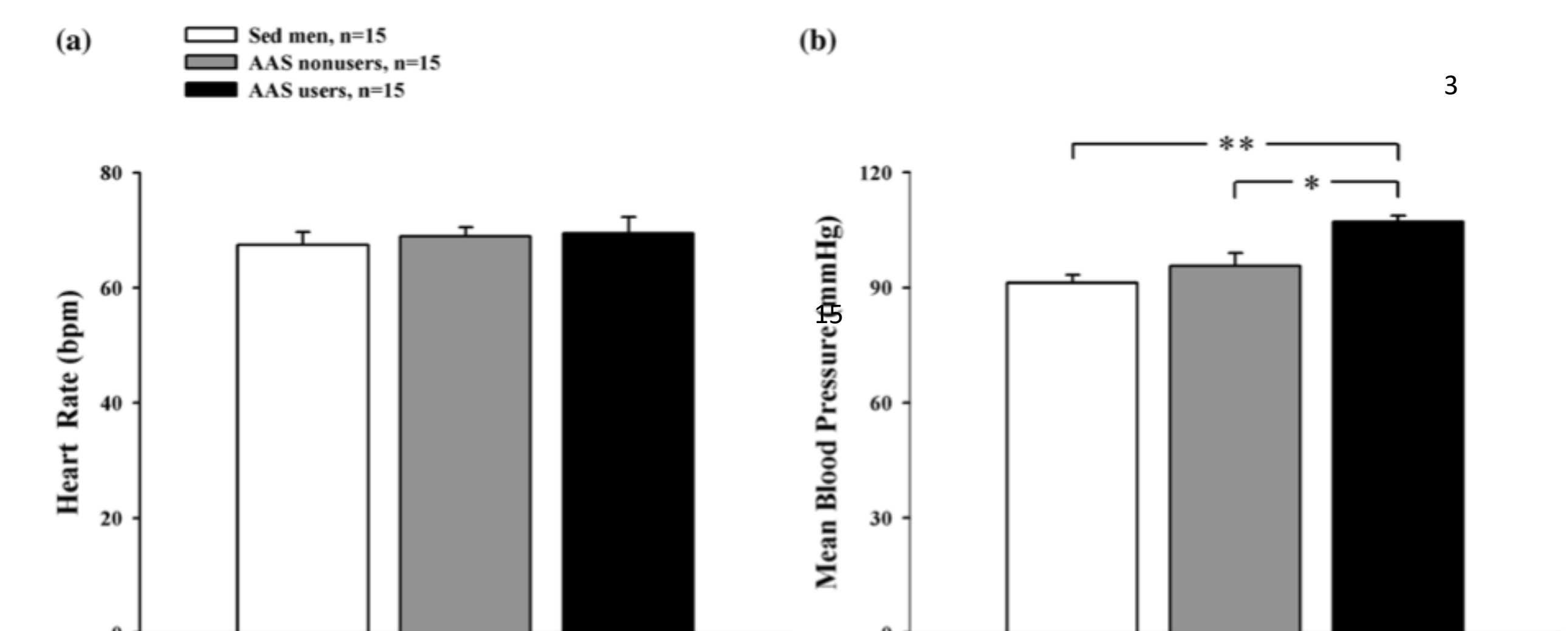


Fig. 1 Graphs showing resting heart rate (HR) (a) and baseline mean blood pressure (MBP) (b) in anabolic androgenic steroid (AAS) users (n = 15), AAS nonusers (n = 15) and sedentary controls (Sed men, n = 15). Data are presented as the mean ± standard error of the mean (SEM). Note that MBP at rest was significantly increased in AAS users compared with the other groups \*p < 0.05, \*\*p < 0.001

Table 2. Echocardiographic Findings in Anabolic-Androgenic Steroid Users and Nonusers\*

Variable	Users (N=86)	Nonusers (N=54)	Comparison	
			Estimated Difference (95% Confidence Interval)†	P Value
<b>Primary outcomes</b>				
Left ventricular ejection fraction, %	52±11	63±8	-10 (-14 to -7)	<0.001
Average early left ventricular E', cm/s	9.3±2.4	11.1±2.0	-1.9 (-2.7 to -1.0)	<0.001
<b>Secondary outcomes</b>				
Resting heart rate, beats/min	65±5	62±6	2.7 (0.7 to 4.7)	0.008
Left atrial diameter, cm‡	3.6±0.5	3.5±0.5	0.1 (-0.1 to 0.2)	0.42
Longitudinal 4-chamber strain§	-16±4	-20±3	4.6 (3.2-6.0)	<0.001
Early lateral ventricular E', cm/s	10.6±3.1	12.5±2.3	-1.8 (-2.9 to -0.8)	<0.001
Early septal ventricular E', cm/s	8.0±2.2	9.8±2.1	-1.9 (-2.7 to -1.1)	<0.001
Left ventricular end diastolic internal diameter, cm	5.0±0.6	4.8±0.5	0.1 (-0.1 to 0.3)	0.30
Left ventricular end systolic internal diameter, cm‡	3.6±0.7	3.2±0.5	0.3 (0.0 to 0.5)	0.018
Left ventricular end diastolic volume, mL	125±38	119±28	-6 (-13 to 12)	0.94
Left ventricular end systolic volume, mL	61±27	45±15	13 (5 to 21)	0.003
Interventricular septum thickness, cm	1.2±0.2	1.1±0.1	0.2 (0.1 to 0.2)	<0.001
Posterior wall thickness, cm	1.2±0.2	1.1±0.2	0.1 (0.0 to 0.2)	0.003
Left ventricular mass, g	245±62	192±40	44 (24 to 63)	<0.001
Left ventricular mass/body surface area, g/m²	111±61	89±18	21 (11 to 30)	<0.001
Left ventricular mass/height, g/m	138±33	107±22	27 (16 to 38)	<0.001
Left ventricular mass/height², g/m²	52±13	40±8	11 (7 to 16)	<0.001
Relative wall thickness	0.49±0.11	0.45±0.08	0.050 (0.014 to 0.087)	0.007

AAS indicates anabolic-androgenic steroids; and E', relaxation velocity.  
 †Data are reported as means±SD.  
 ‡Estimated mean differences between groups adjusted for age, race, family history of coronary artery disease, cocaine dependence, regular tobacco use, alcohol dependence, aerobic exercise in the past 10 y, and body surface area by the Mosteller formula.  
 §N=85 AAS users.  
 ¶N=84 AAS users.

## Sources

1. Baggish AL, Weiner RB, Kanayama G, et al. Cardiovascular Toxicity of Illicit Anabolic-Androgenic Steroid Use. *Circulation*. 2013;128(21):1991-2002. doi:10.1161/CIRCULATIONAHA.116.026945
2. Bhatnagar PB, Roumie M. Building Body With Anabolics is Weakening the Heart: Anabolic Steroid Induced Cardiomyopathy. *Cureus*. 2022;14(7):e26579. doi:10.7755/cureus.26579
3. Barbosa Neto O, da Mota GR, De Sordi CC, et al. Long-term anabolic steroids in male bodybuilders induce cardiovascular structural and autonomic abnormalities. *Clin Auton Res*. 2017;28(2):231-244. doi:10.1007/s10286-017-0470-2
4. Rasmussen JJ, Schou M, Madsen PL, et al. Cardiac systolic dysfunction in past illicit users of anabolic androgenic steroids. *Am Heart J*. 2018;203:49-56. doi:10.1016/j.ahj.2018.06.010
5. Reyes-Vallajo L. Current use and abuse of anabolic steroids. *Actas Urol Esp (English Edition)*. 2020;44(5):309-311. doi:10.1016/j.acuroe.2019.10.007