

"Muscle Building" Nutritional Supplements: Is Androstenedione An Anabolic Steroid?

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Roger Maris

61 Home Runs in a Season

1961

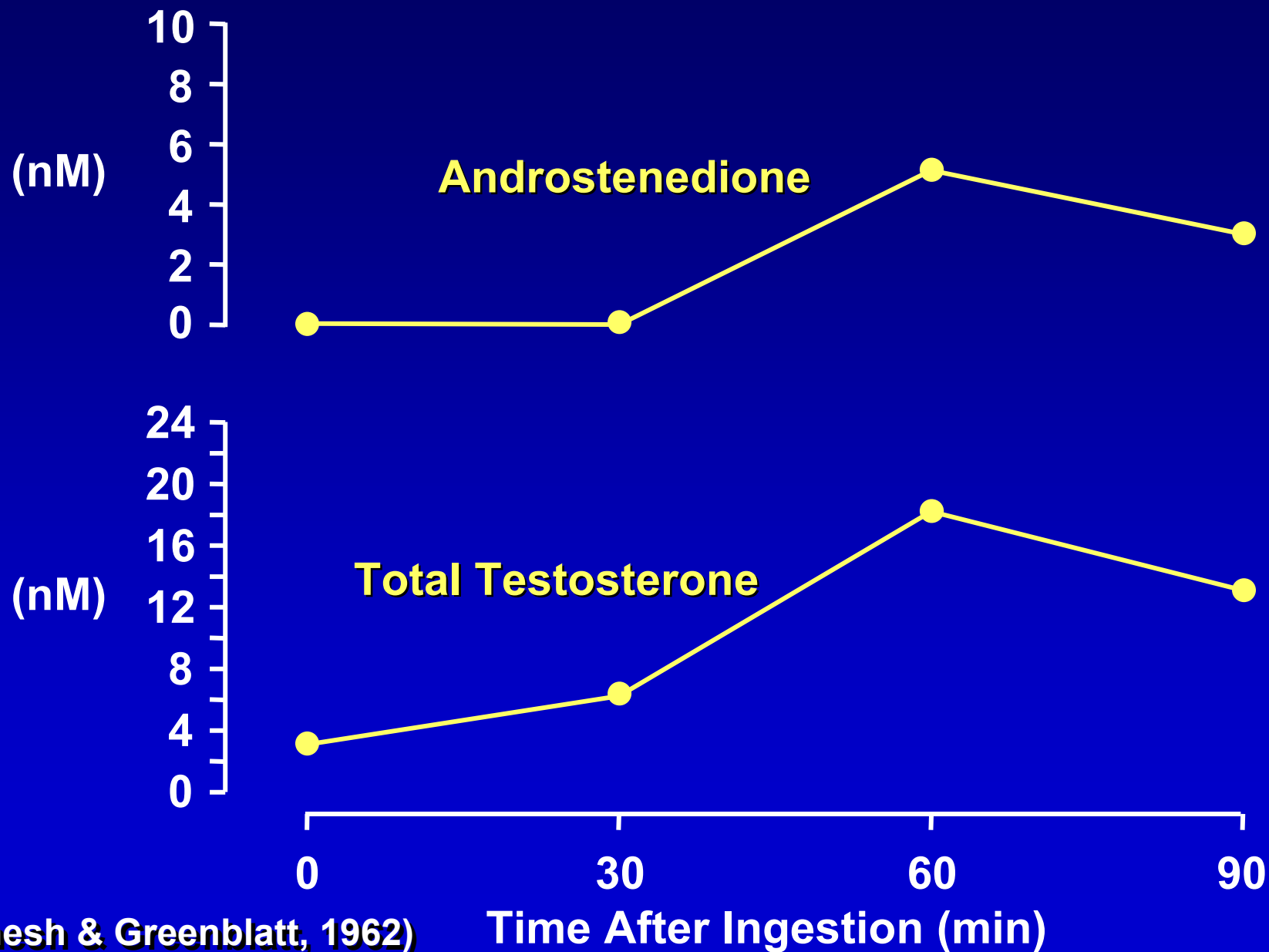


Mark McGwire

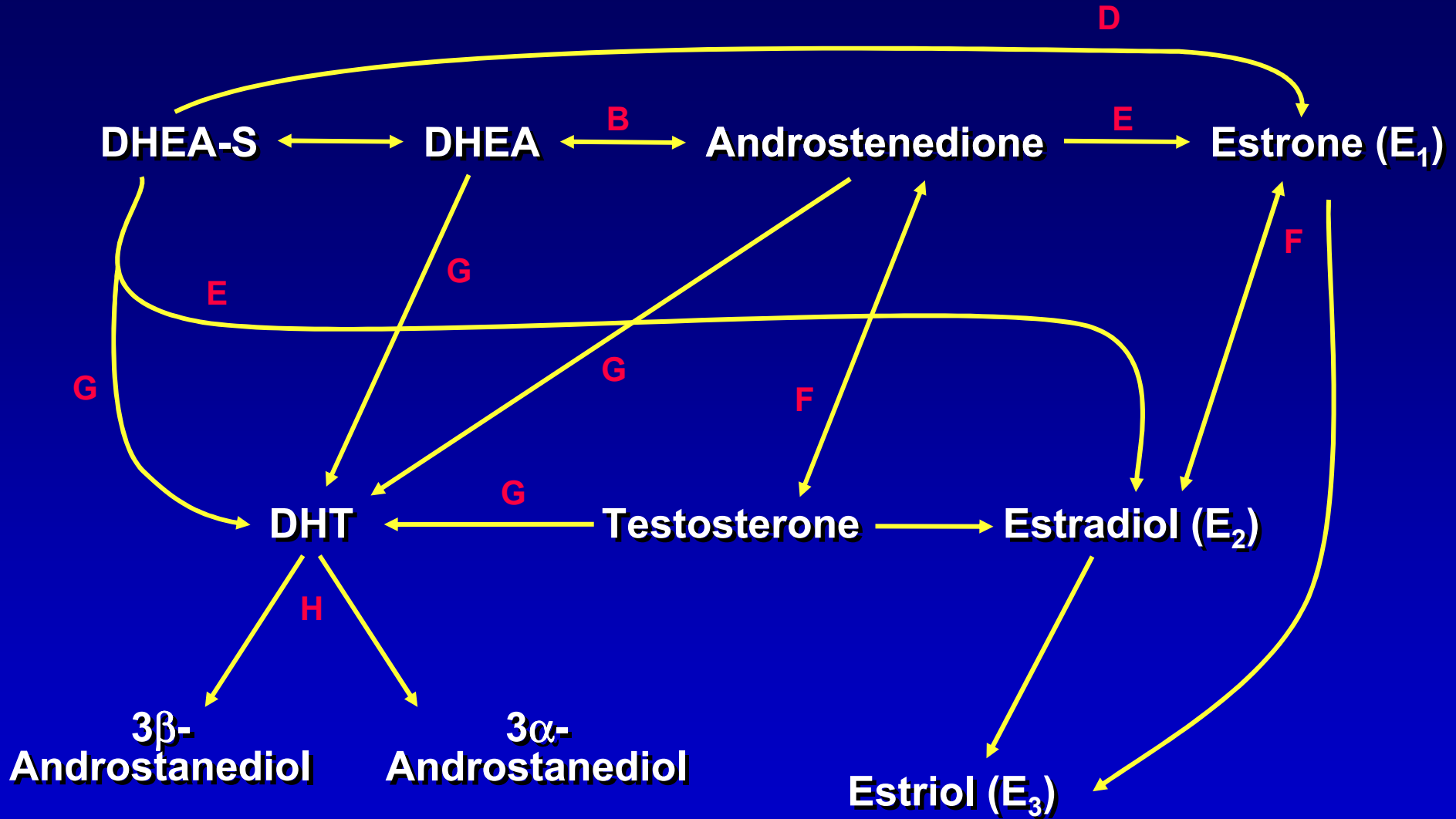
70 Home Runs in a Season

1998

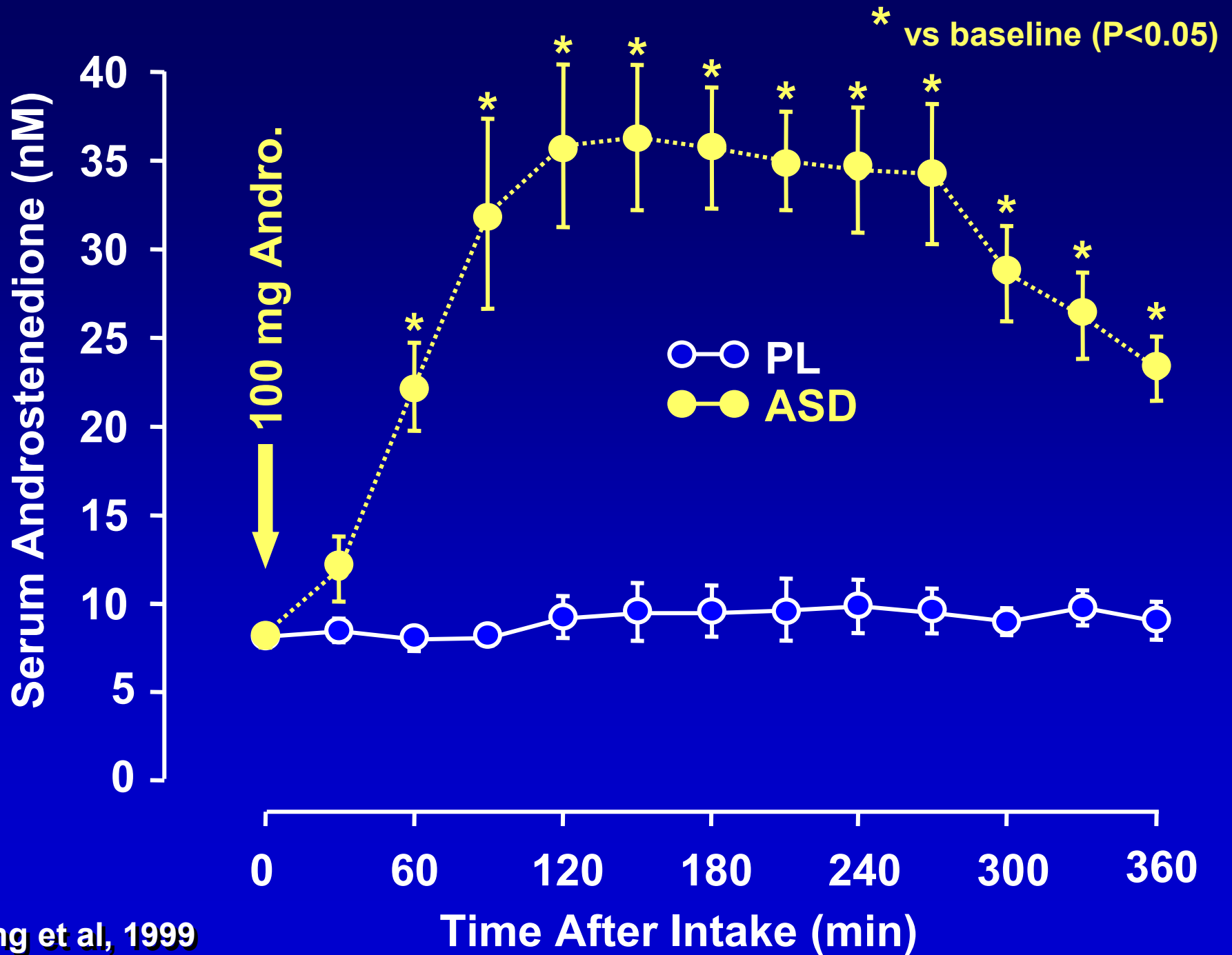
Serum androgen levels after intake of 100 mg Androstenedione in Two Women

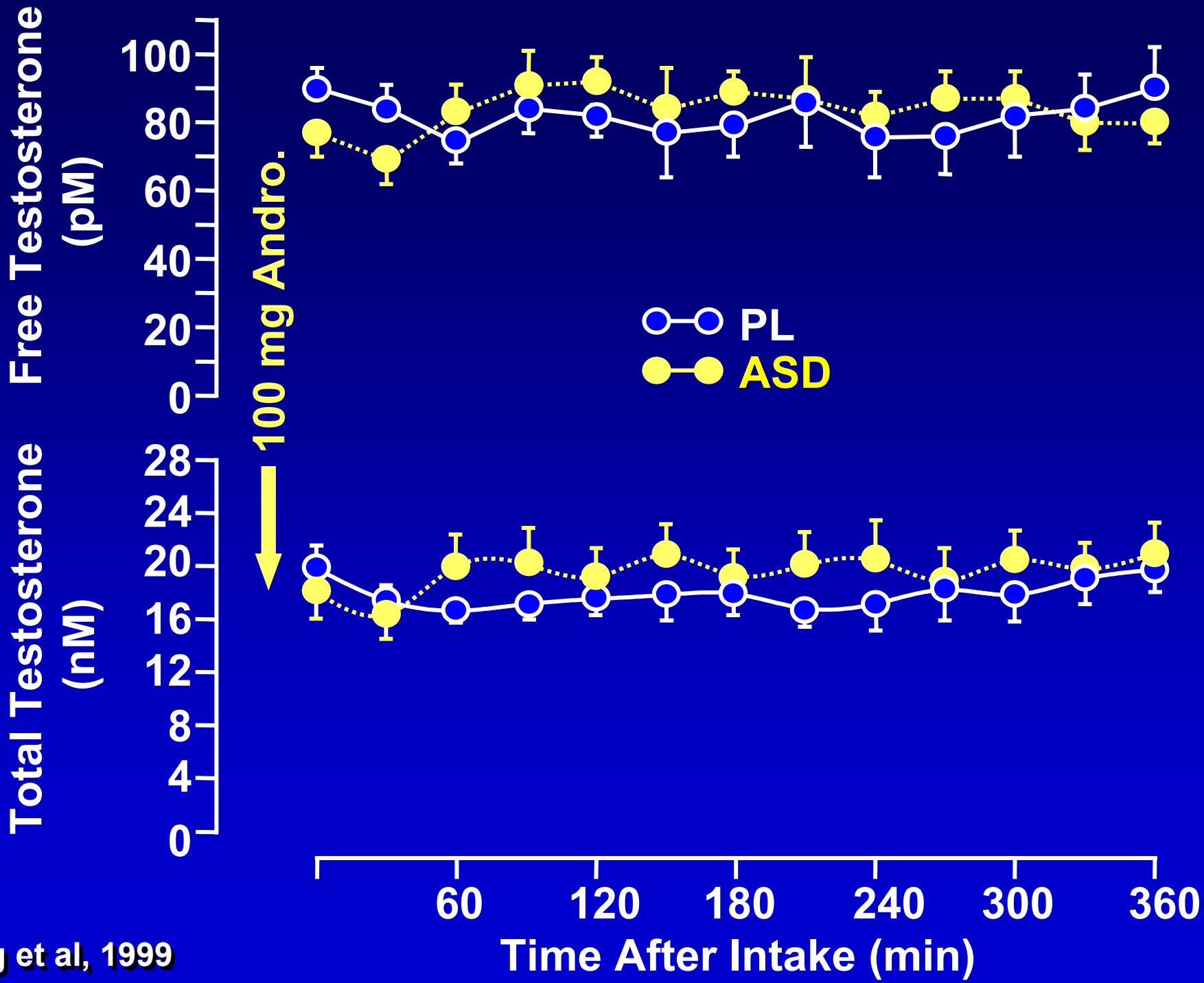


Androgen and Estrogen Relations



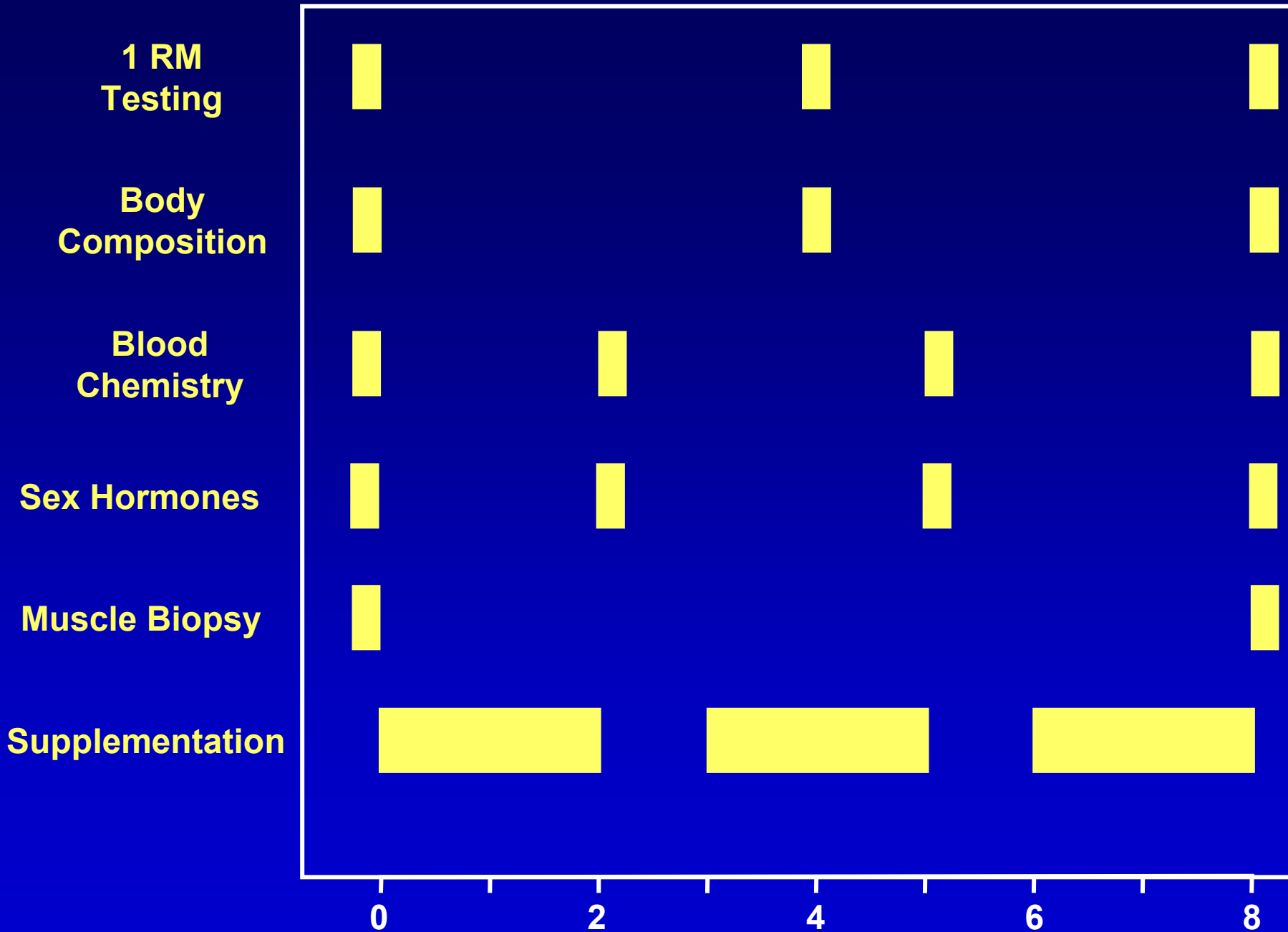
**Does acute androstenedione
intake alter serum hormone
concentrations in young men?**

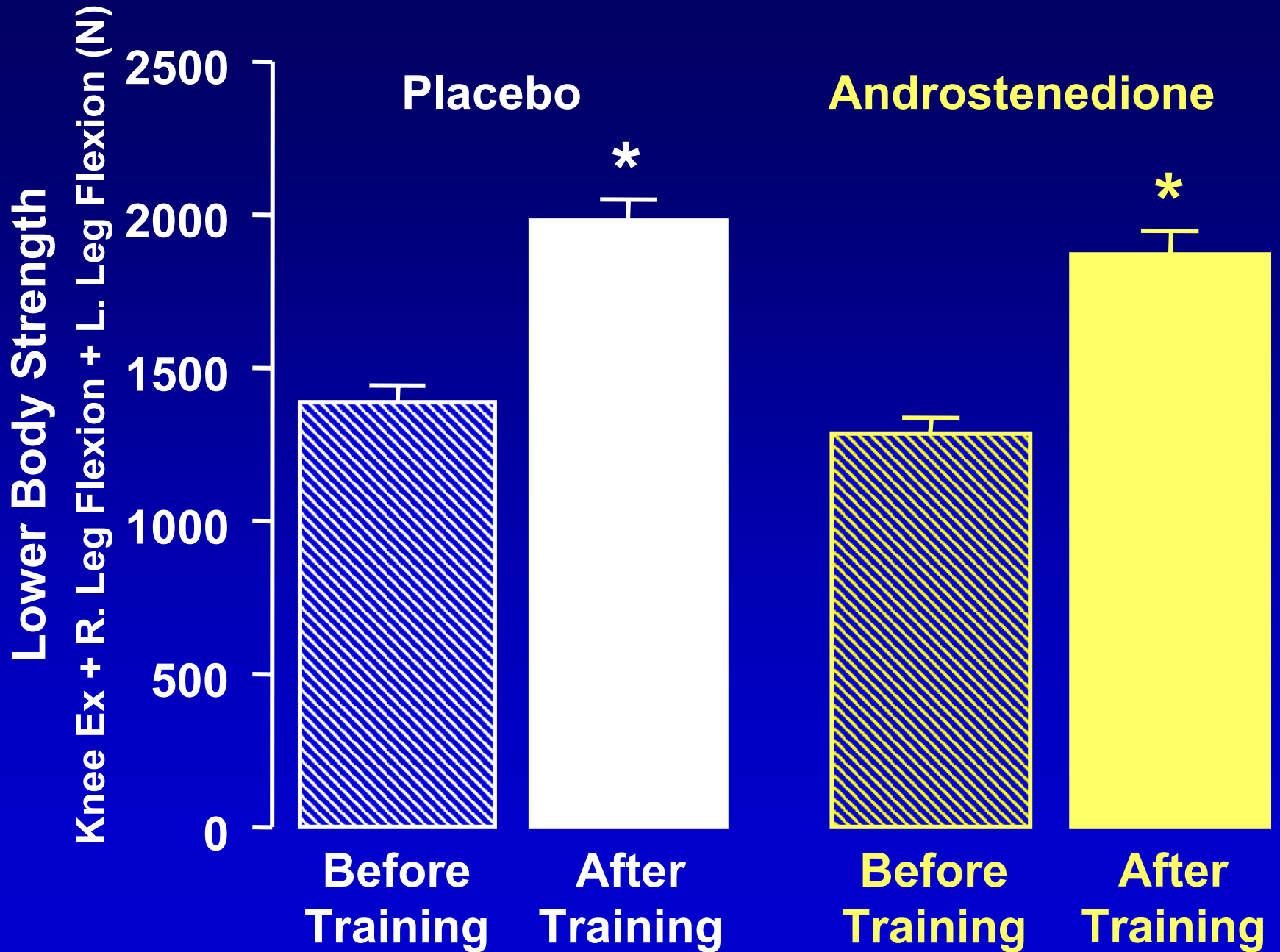


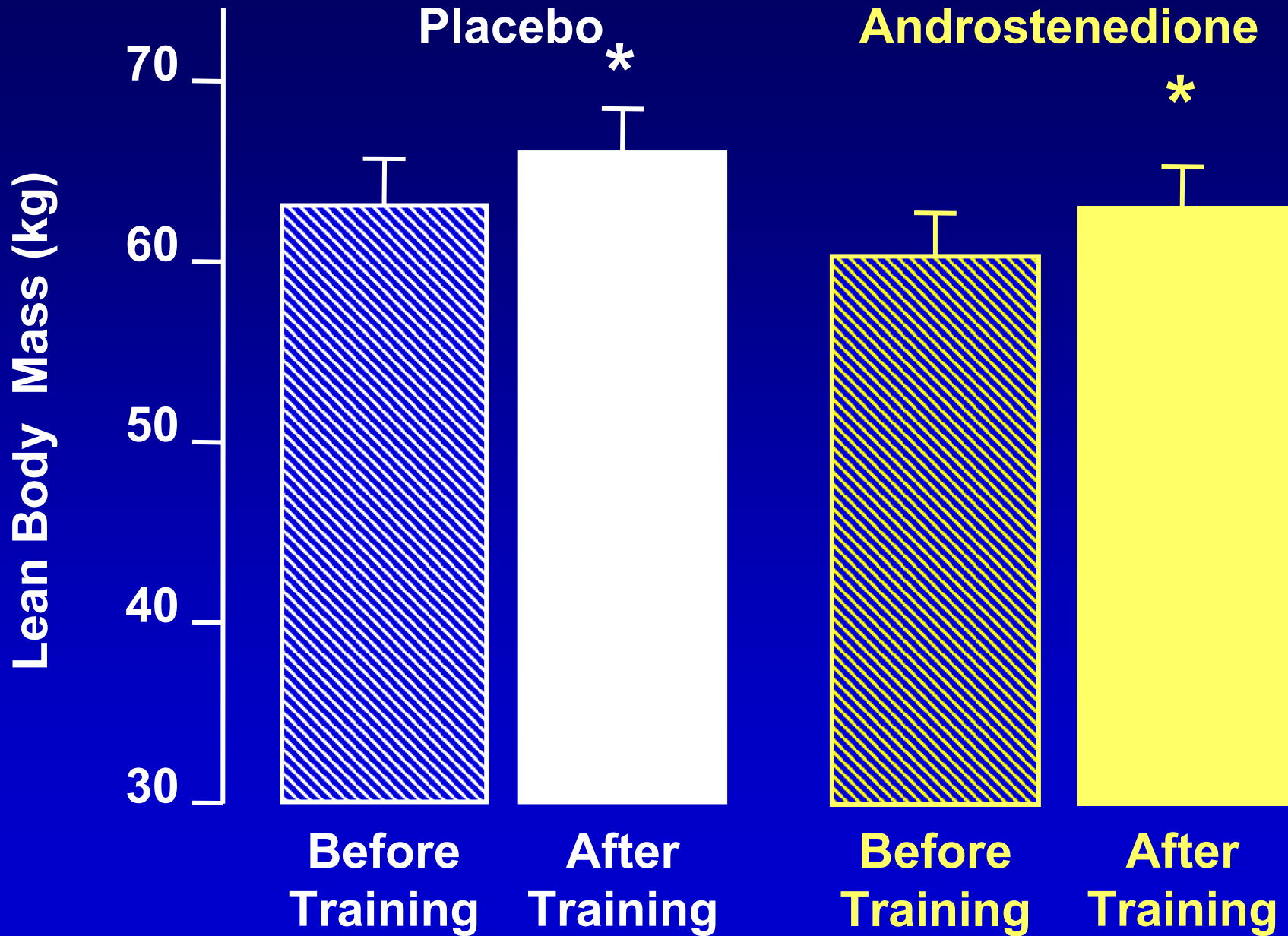


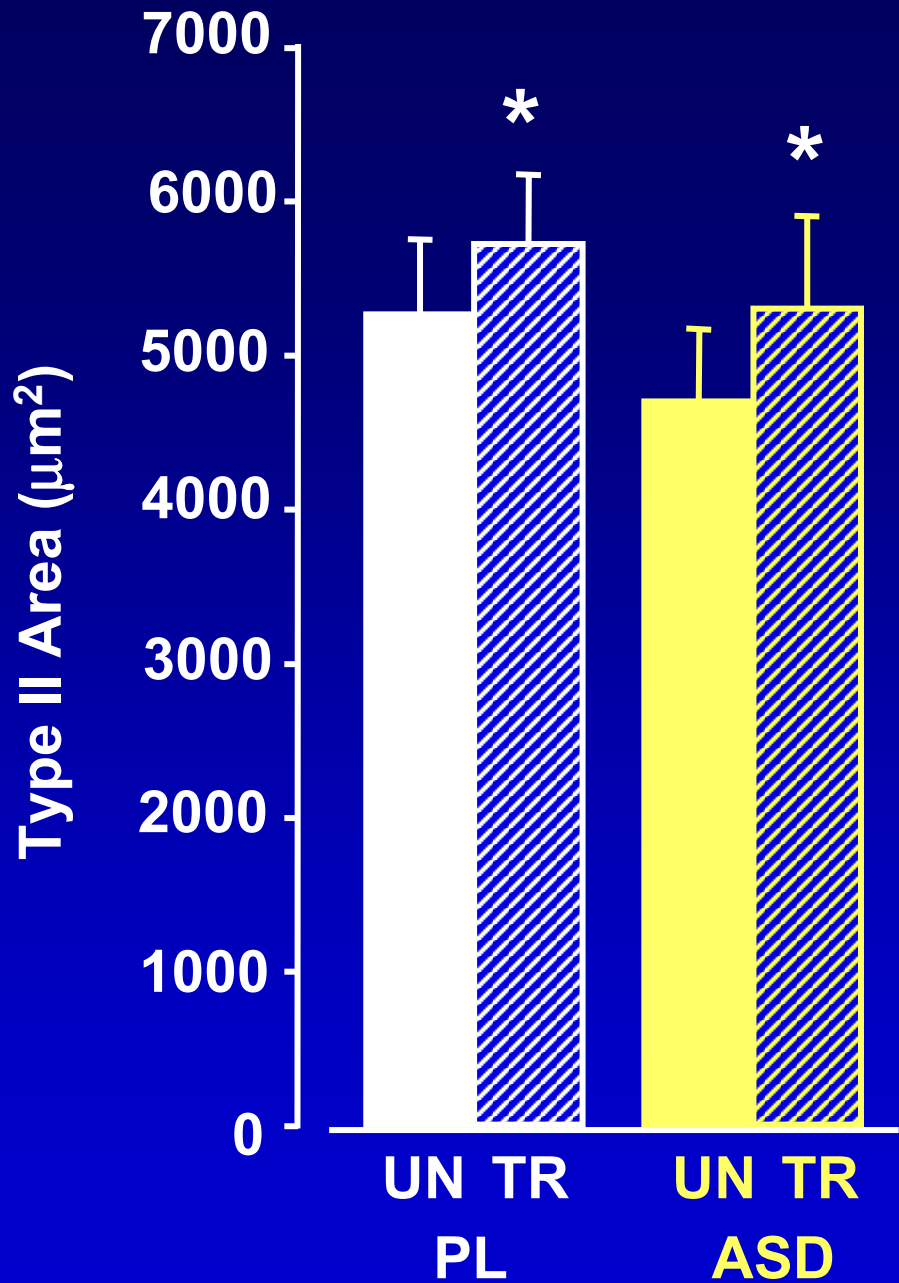
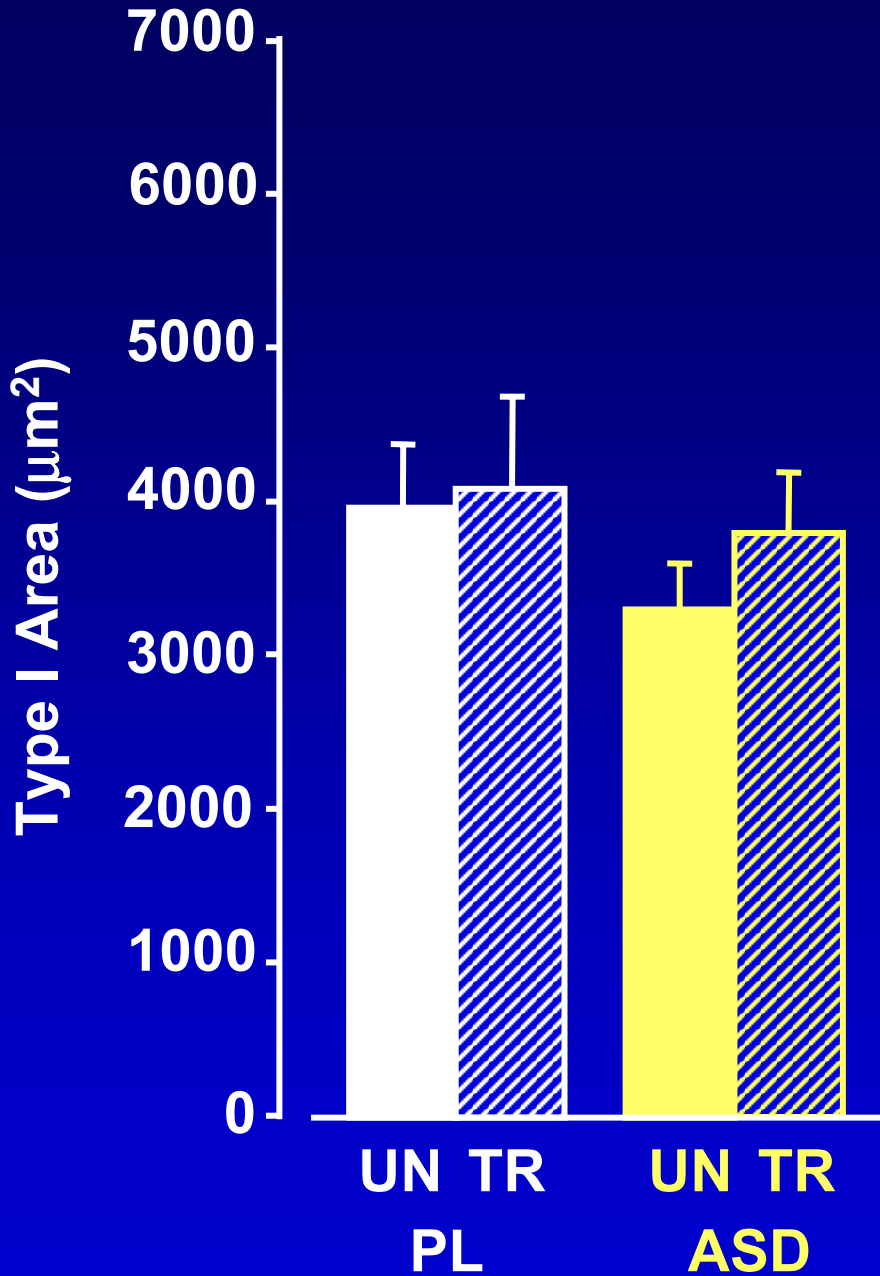
**Does Chronic Androstenedione
Intake Enhance The Gains In
Muscle Size and Strength
During Resistance Training?**

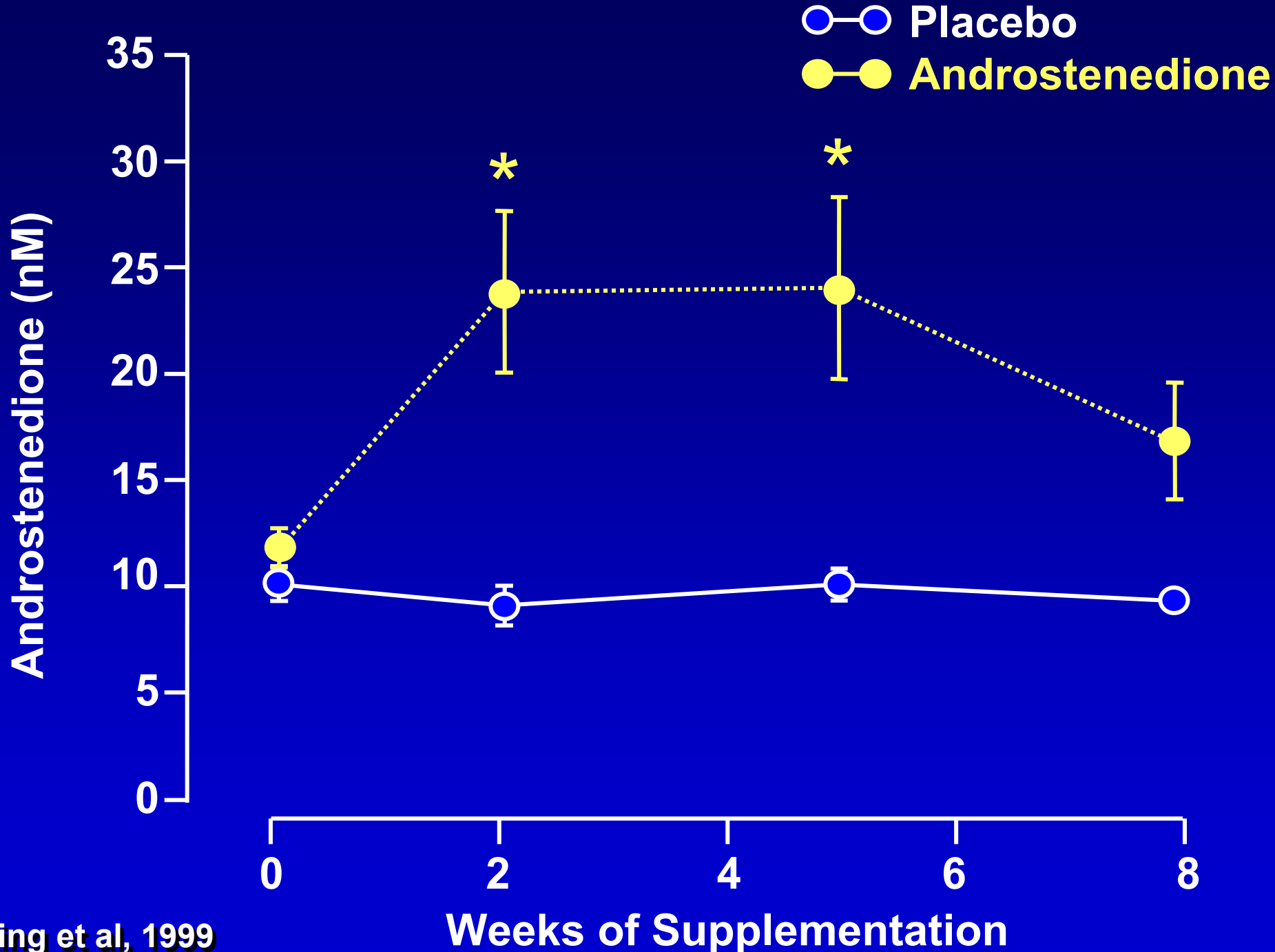
- **20 untrained subjects**
 - **Male (~23 y)**
 - **No current/previous supplement or steroid use**
- **8 weeks full body resistance training**
 - **3 days/week**
 - **80-85% 1 RM**
- **Random, double blind**
 - **PL (rice flour)**
 - **Androstenedione (100 mg *t.i.d*)**

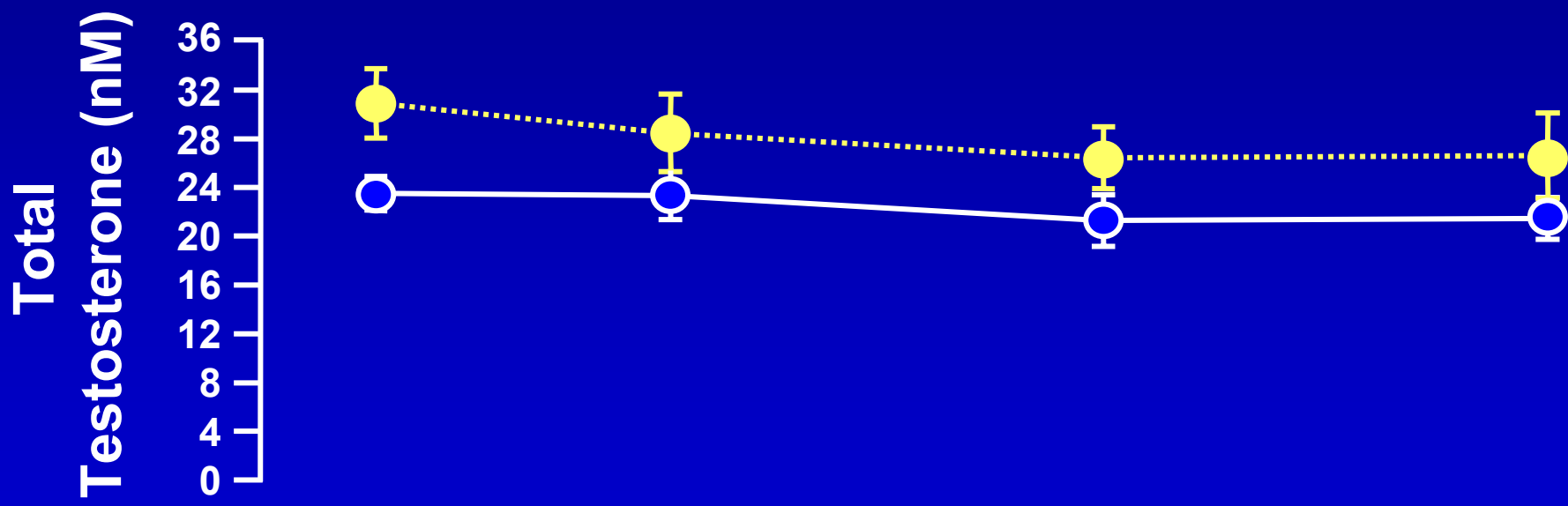
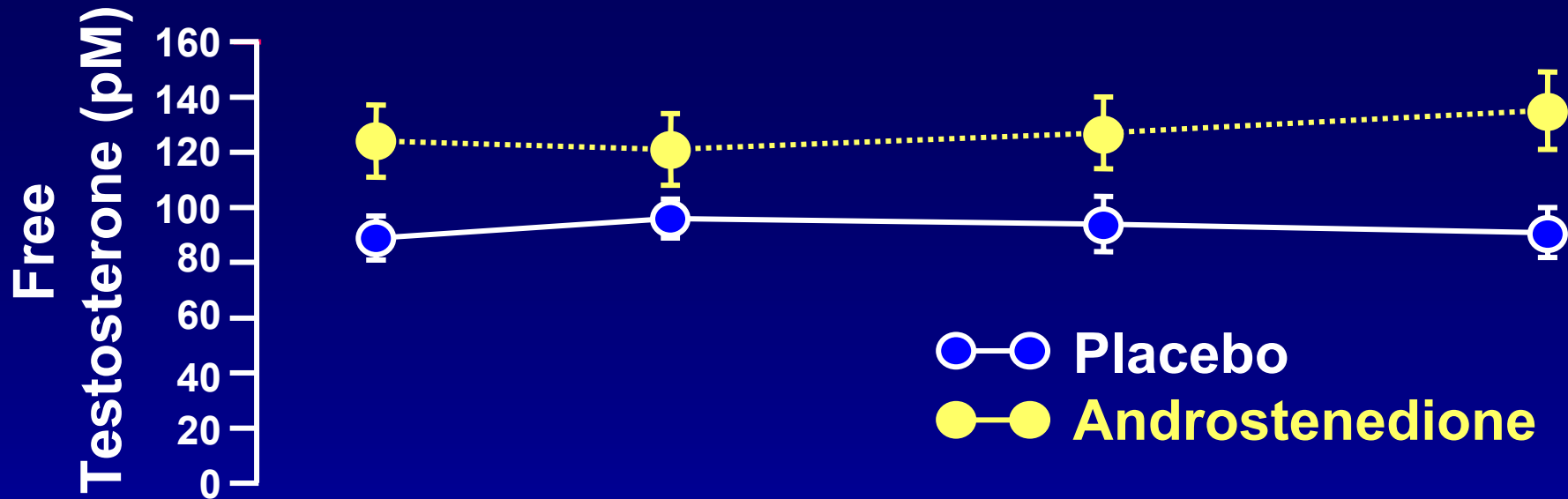








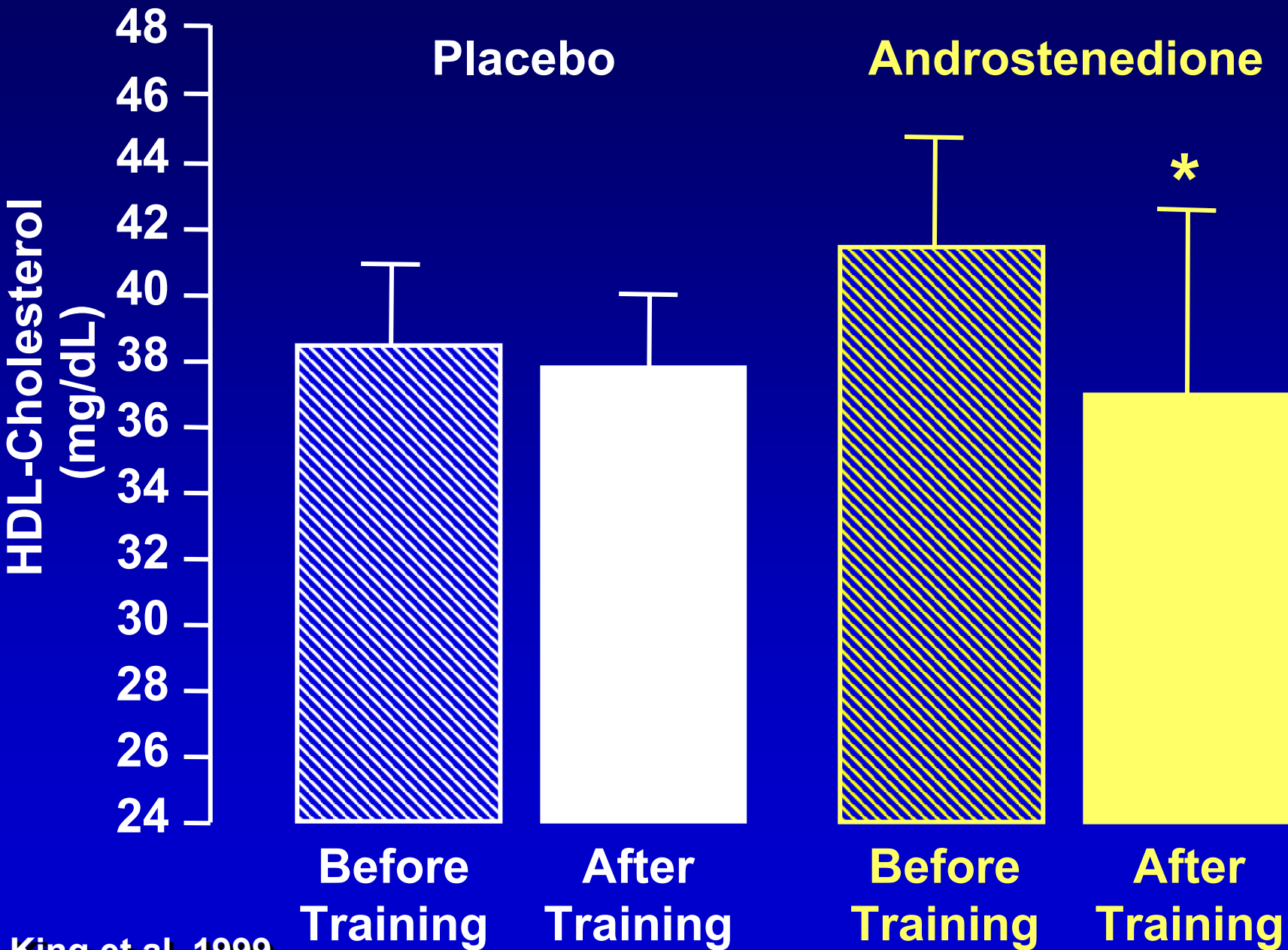




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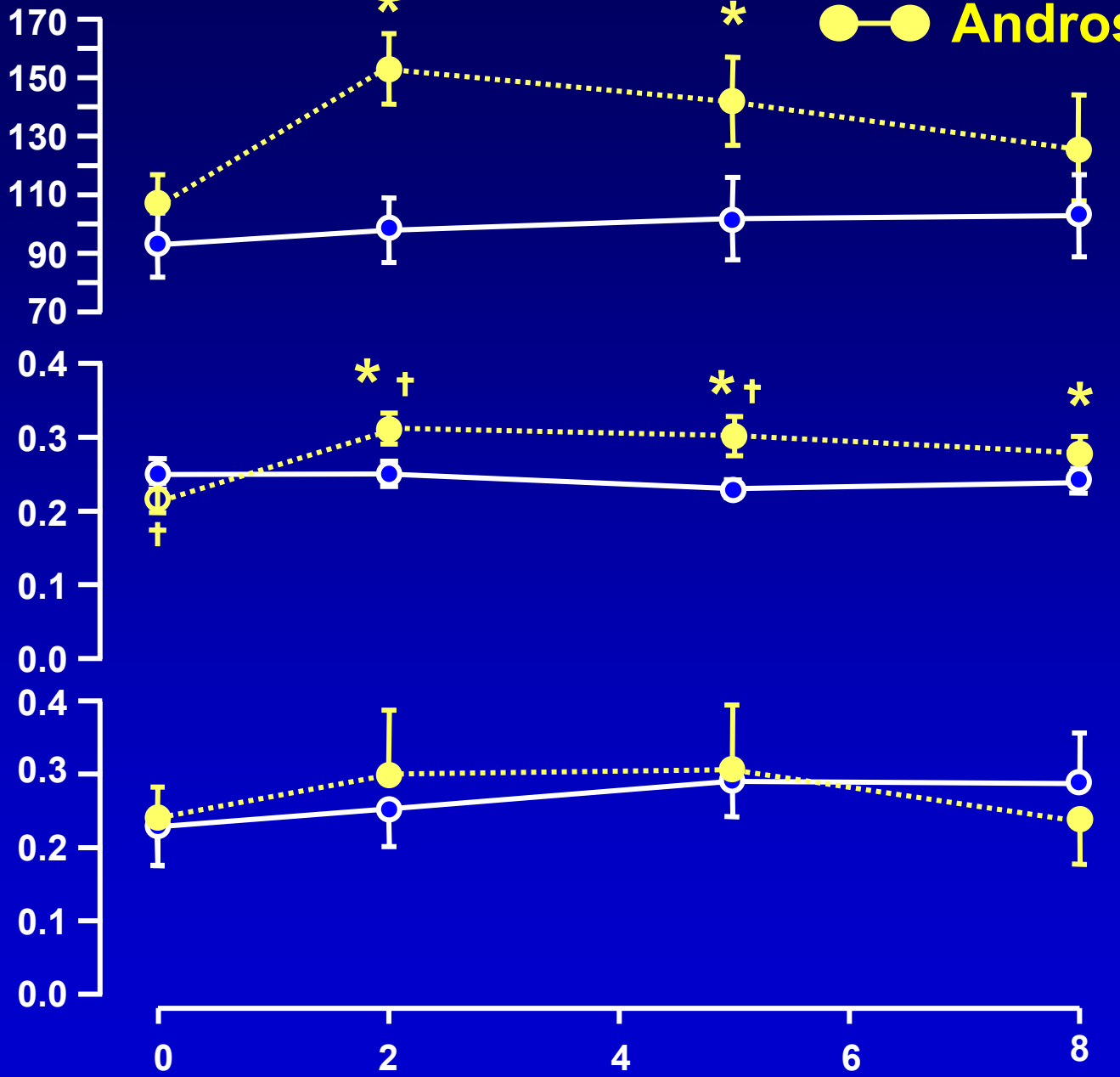
Weeks of Supplementation

**Is Androstenedione Intake
Safe?**



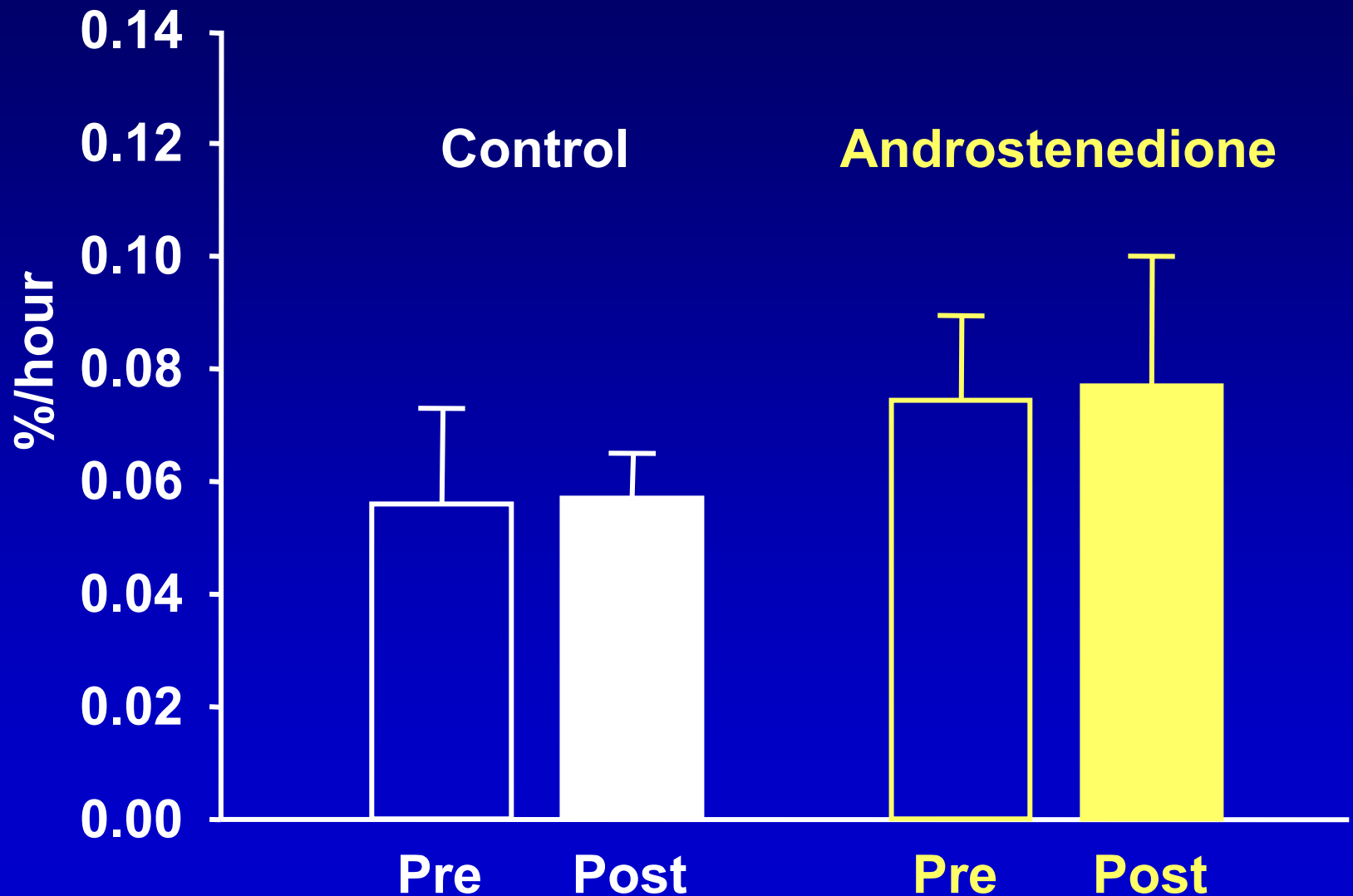
Estriol (E₃: nM) Estradiol (E₂: nM) Estrone (E₁: pM)

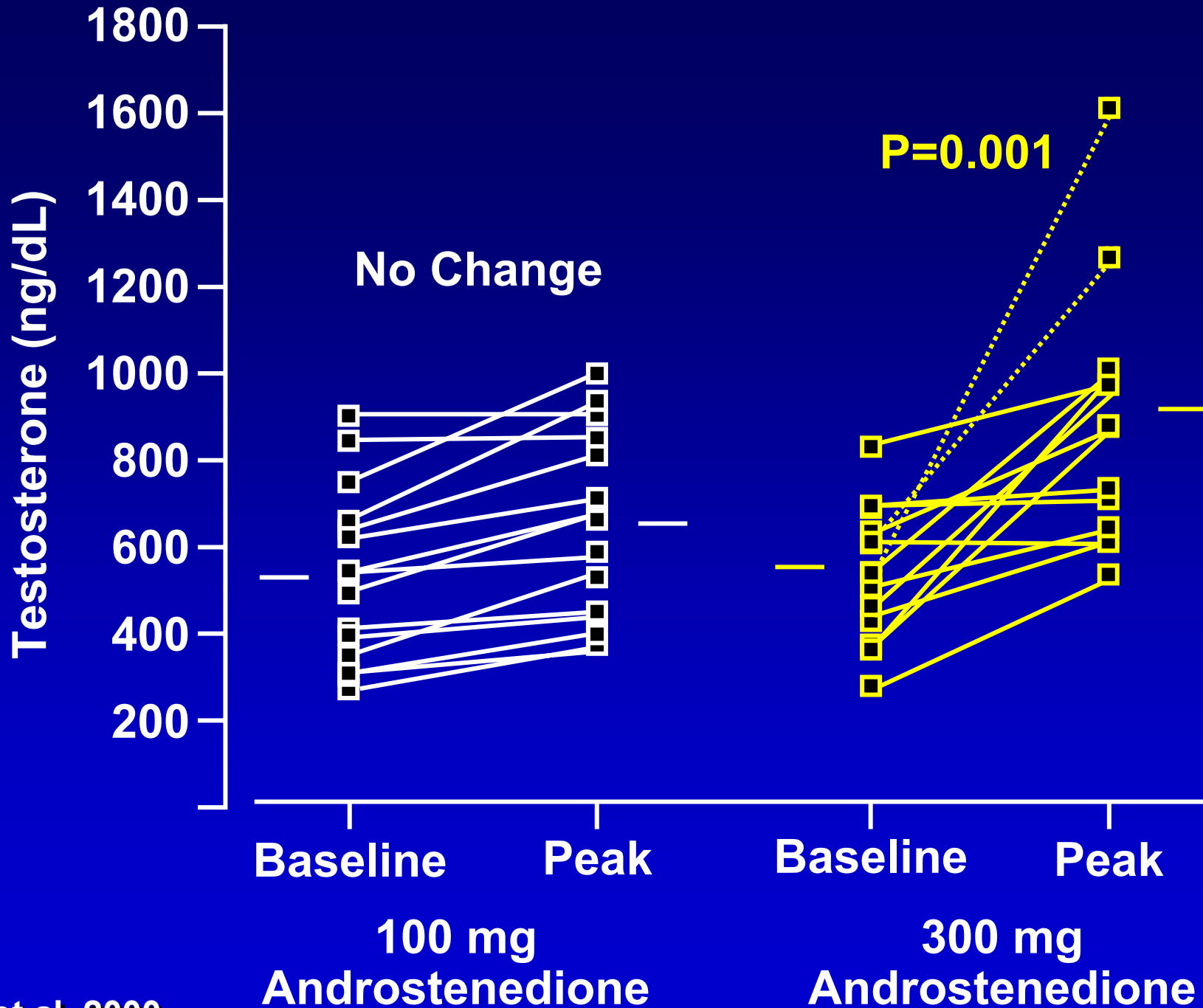
○ Placebo
● Androstenedione



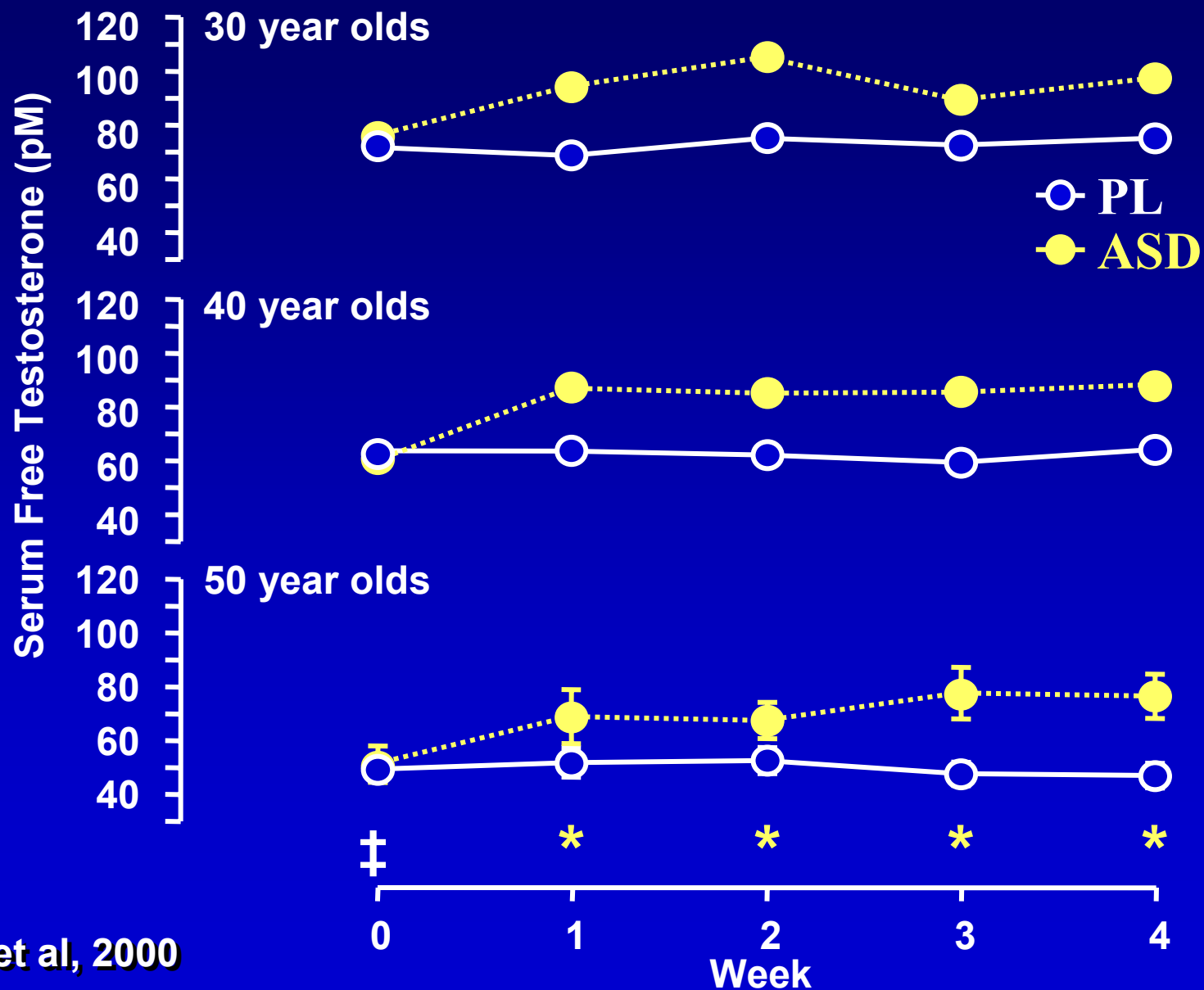
Other Notable Findings

Effect of 100 mg androstenedione/day on Muscle Protein Fractional Synthetic Rate

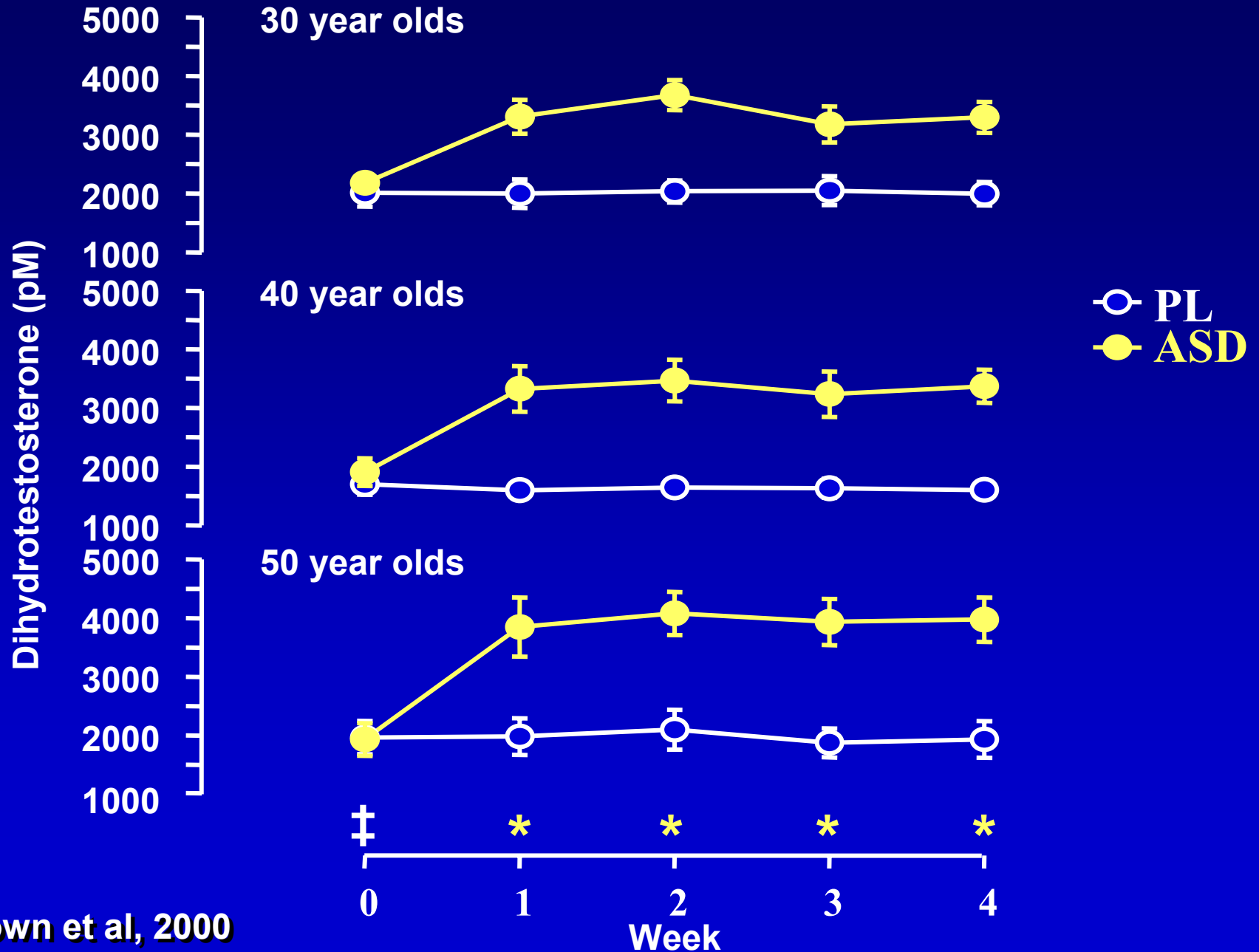




Effect of 100 mg androstenedione t.i.d. in different ages



Effect of 100 mg androstenedione t.i.d. in different ages



To Summarize

- **Chronic androstenedione intake in doses up to 100 mg t.i.d. does not enhance**
 - **The increase in muscle mass and strength associated with resistance training**
 - **Serum testosterone**
 - **Muscle protein synthesis**

To Summarize

- **Chronic androstenedione intake in doses up to 100 mg t.i.d. does**
 - **Increase Serum Dihydrotestosterone**
 - **Increase Serum Estrogens**
 - **Decrease Serum HDL-C**

Possible Adverse Health Consequences

Lowered HDL-C

- Increased CV disease risk by 10-15%

Elevated Estrogens Have been linked to...

- Increased CV disease risk
- Pancreatic Cancer
- Gynecomastia

Possible Adverse Health Consequences

Elevated Androstenedione may be associated with...

- **Prostate Cancer**
- **Pancreatic Cancer**
- **Neural/Behavioral**

Elevated Dihydrotestosterone has been linked to...

- **Benign Prostate Hypertrophy**
- **Baldness**

Herbal Extracts

Compound	Daily Dose	Purpose
Saw Palmetto	480 mg	Reduce DHT metabolism/ binding Inhibit 5 α reductase
Indole 3 Carbinol	450 mg	Inhibit formation of estrogens
Tribulus Terristris	1,350 mg	Increase LH, FSH, Testosterone
γ Linolenic Acid	1500 mg	Inhibit 5 α reductase
Chrysin	300 mg	Inhibit aromatization

Addition of These Herbal Extracts

- **Does not prevent formation of estrogens from androstenedione, and**
- **Does not increase serum testosterone levels.**

Future Directions

- **To what extent do greater (>300 mg/d) doses of androstenedione affect serum testosterone, muscle strength and size?**

Future Directions

- **What are the long term health consequences of prolonged androstenedione intake?**
 - **Cardiovascular Risk**
 - **Fertility**

Future Directions

- **What are the effects of age and gender on modifying the response to androstenedione?**
- **What are the effects of alternative modes of delivery?**

Future Directions

- **What are the effects of other andro compounds?**
- **What are the effects of combining various forms of andro?**

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Kerry A. Parsons, M.S.

David A. Jackson, M.S.

N.L. Uhl, B.S.

Emily R. Martini, B.S.

Douglas S. King, PhD

We are grateful to



For their support.

Extra Slides



A NEW STUDY SAYS
THE STEROID "ANDRO,"
TAKEN BY MARK MCGWIRE,
DOESN'T BUILD MUSCLE
AND MAY CAUSE ENLARGE-
MENT OF BREAST TISSUE...

...MR. MCGWIRE, ON A
VICTORIA'S SECRET
SHOOT, WAS
UNAVAILABLE FOR
COMMENT...

Extra Summary of Other Clinical Findings

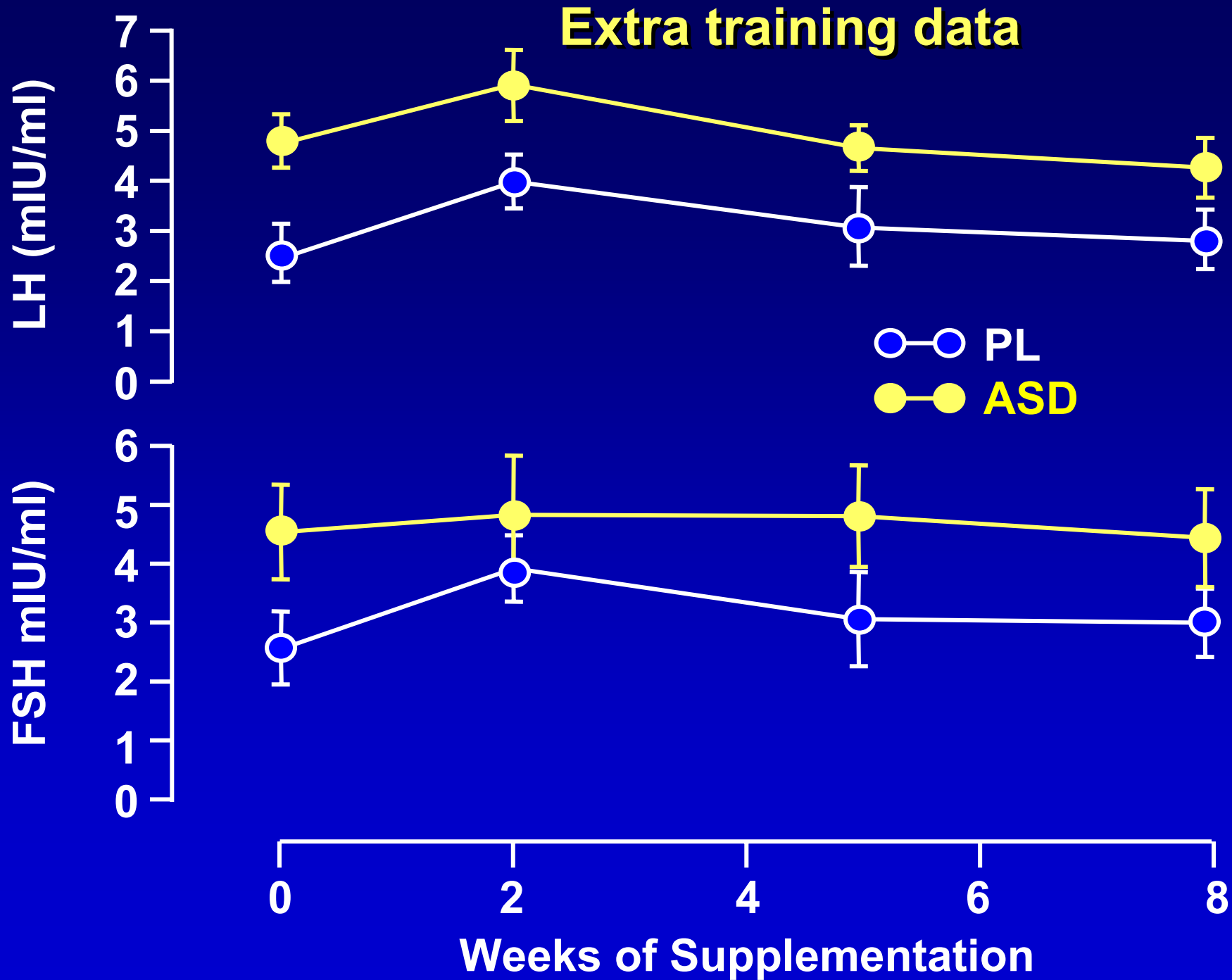
- **Chronic androstenedione intake in doses up to 100 mg t.i.d. does not alter serum concentrations of**
 - **Low Density Lipoprotein**
 - **Very Low Density Lipoprotein**
 - **Gamma-glutamyltransferase**
 - **Aspartate aminotransferase**
 - **Alanine aminotransferase**
 - **Globulins**
 - **Proteins**
 - **Prostate Specific Antigen**

Extra Summary

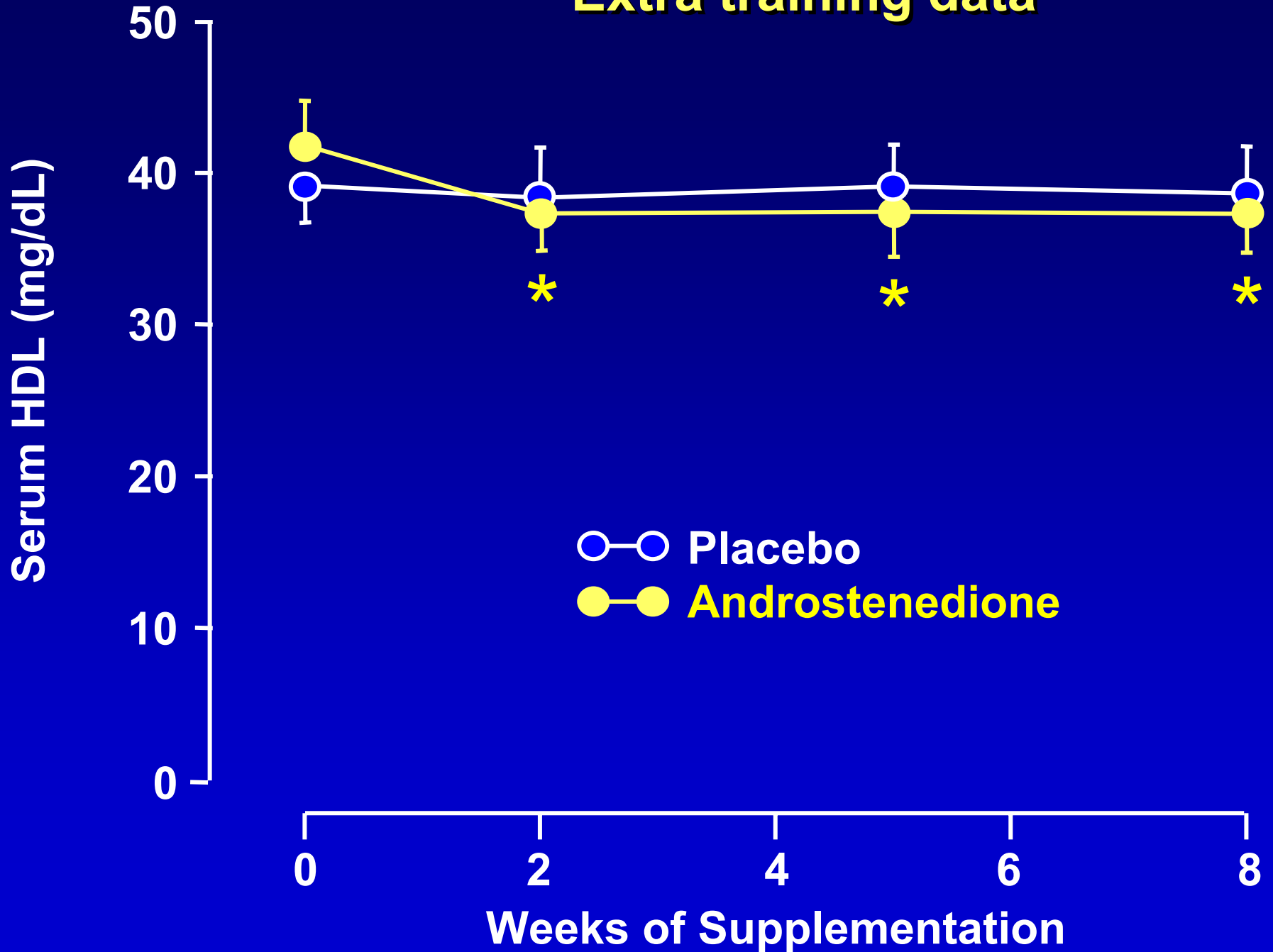
- **A single 100-200 mg dose of androstenedione does not increase serum concentrations of testosterone in young men.**
- **A single 300 mg dose of androstenedione may slightly increase serum concentrations of testosterone**

Extra Summary

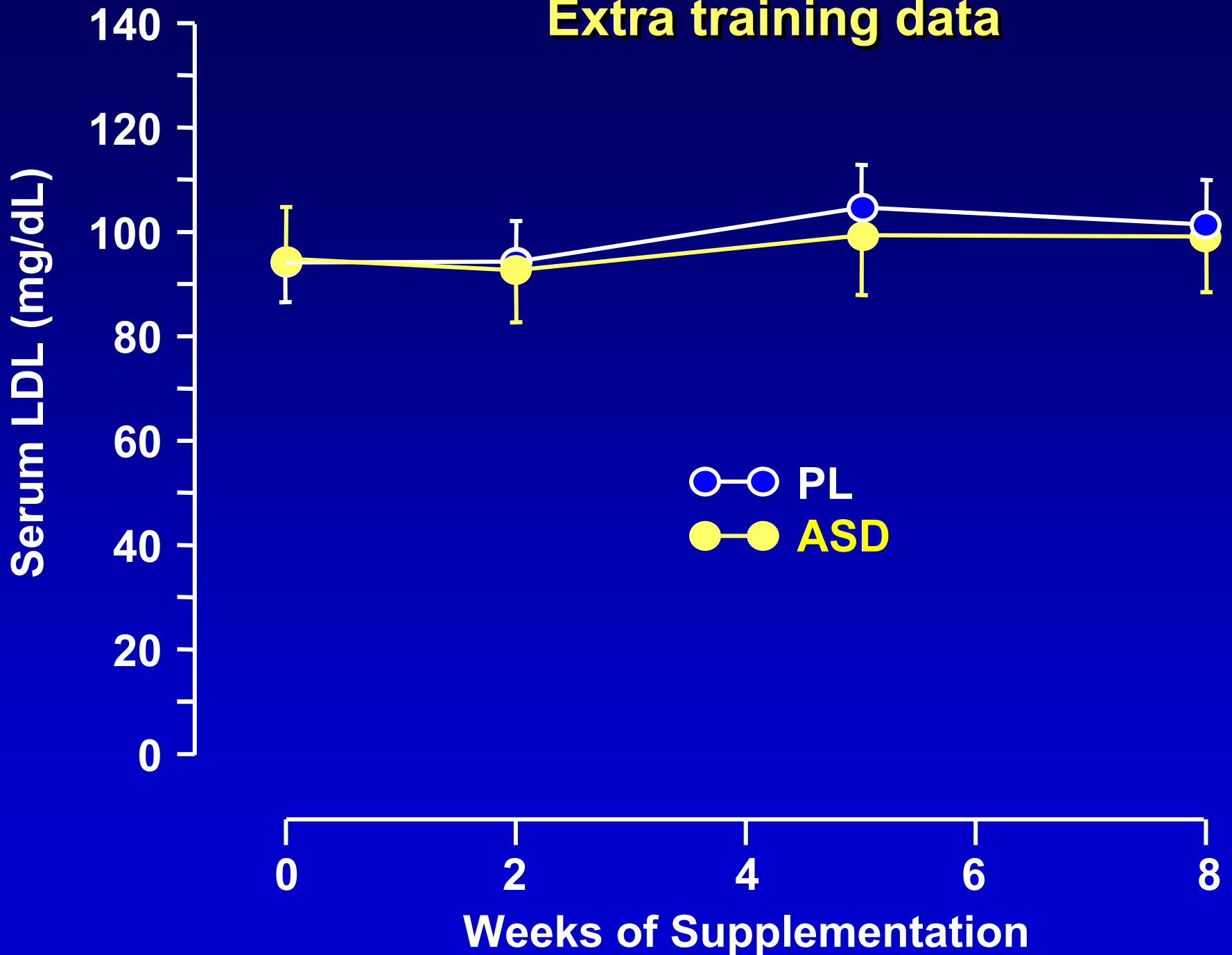
- Chronic androstenedione intake in doses up to 100 mg t.i.d. does not enhance
 - Serum testosterone
 - Muscle protein synthesis
 - Adaptations to resistance training
 - lean mass
 - fat mass
 - muscle fiber size
 - muscle strength



Extra training data



Extra training data



Maximal Muscle Strength (N)**Extra training data**

	ASD (n=9)		PL (n=10)	
	Wk 0	Wk 8	Wk0	Wk 8
Bench Press *	647 ± 68	840 ± 73	851 ± 95	1,047 ± 119
Biceps Curl *	287 ± 19	331 ± 22	351 ± 21	391 ± 25
Knee Extension *	717 ± 46	1,024 ± 57	770 ± 45	1,095 ± 52
Lat Pulldown *	657 ± 25	787 ± 44	672 ± 35	876 ± 50
Left Leg Flexion *	277 ± 17	415 ± 22	307 ± 11	440 ± 18
Right Leg Flexion*	292 ± 14	430 ± 28	311 ± 10	445 ± 16
Shoulder Press *	420 ± 28	463 ± 27	494 ± 51	569 ± 50
Triceps Extension *	311 ± 24	390 ± 19	329 ± 31	454 ± 30
Vertical Butterfly *	774 ± 107	1,081 ± 94	927 ± 99	1,268 ± 89

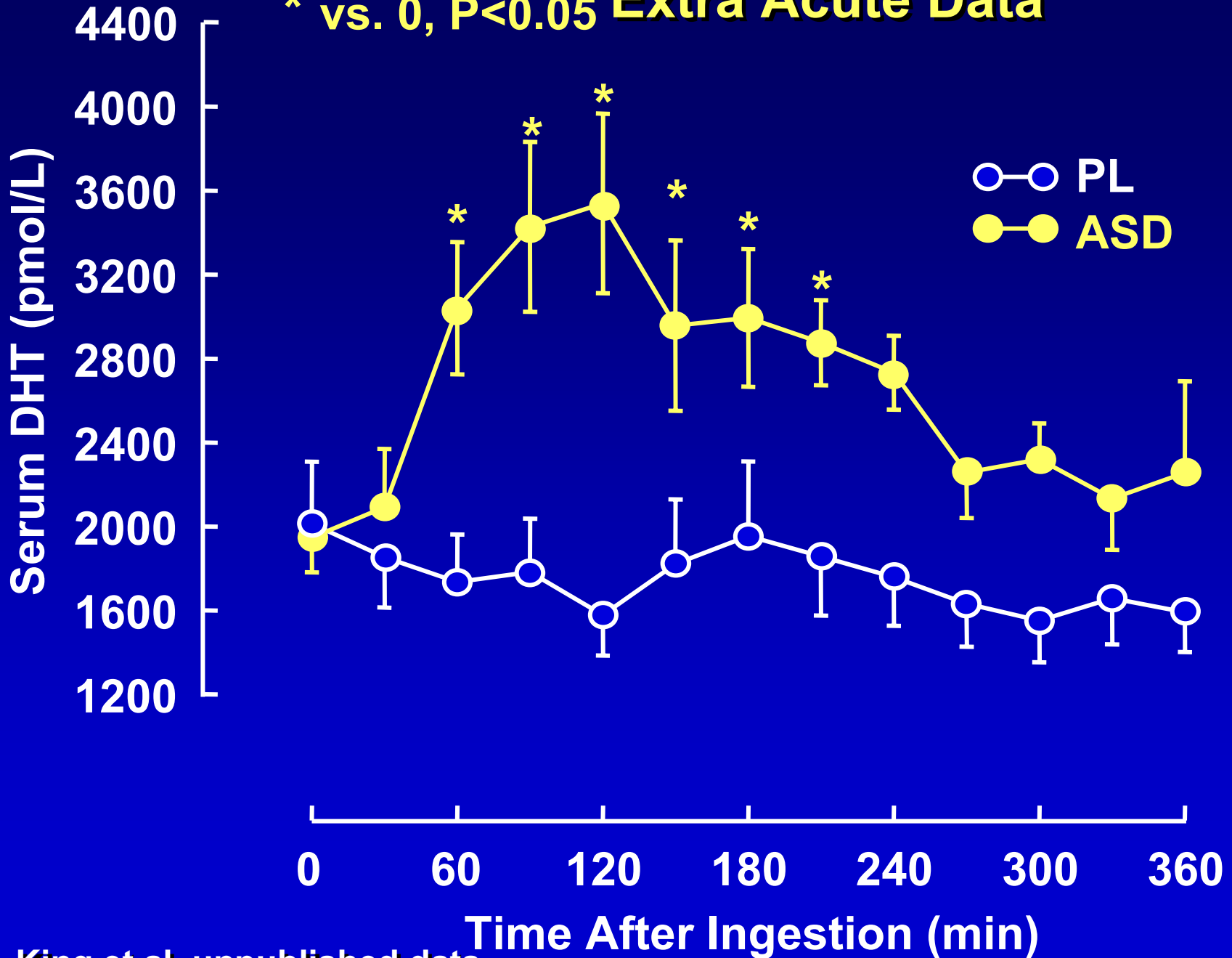
* Week 8 vs week 0 (main effect; P<0.05)

Extra training data

Body Composition - * Wk 8 significantly different from Wk 0 (main effect, P<0.05)

	ASD (n=9)		PL (n=10)	
	Wk 0	Wk 8	Wk0	Wk 8
Height, cm	176.8 ± 2.7	178.0 ± 1.5		
Body Mass, kg *	80.6 ± 4.1	81.2 ± 4.2	81.1 ± 5.2	83.2 ± 4.9
Lean Body Mass, kg *	61.2 ± 2.5	64.1 ± 2.4	63.1 ± 2.6	66.0 ± 2.5
Fat Mass, kg *	19.3 ± 2.9	17.1 ± 3.4	18.0 ± 2.9	17.2 ± 2.9
Body Fat, % *	23.5 ± 2.4	20.3 ± 3.0	21.3 ± 1.9	19.9 ± 2.1
Circumferences, cm				
Biceps *	31.9 ± 0.8	32.4 ± 0.8	32.6 ± 1.4	33.4 ± 1.3
Shoulder *	119.3 ± 1.3	121.1 ± 1.4	120.3 ± 3.4	120.7 ± 3.3
Chest *	99.6 ± 2.0	99.2 ± 1.9	98.0 ± 3.8	100.9 ± 3.4
Abdomen *	89.5 ± 5.2	87.7 ± 5.1	87.2 ± 3.8	85.9 ± 3.6
Waist *	86.6 ± 4.2	83.7 ± 3.6	84.9 ± 3.9	83.7 ± 3.7
Hips *	91.3 ± 3.5	88.1 ± 3.7	89.2 ± 2.5	85.7 ± 2.3
Gluteal *	101.7 ± 3.1	98.2 ± 3.1	100.4 ± 2.5	97.4 ± 2.3
Thigh	54.2 ± 1.3	54.4 ± 1.8	54.7 ± 1.2	55.1 ± 1.5
Calf	37.8 ± 0.7	37.6 ± 0.8	37.4 ± 1.7	38.6 ± 0.9

*** vs. 0, P<0.05 Extra Acute Data**

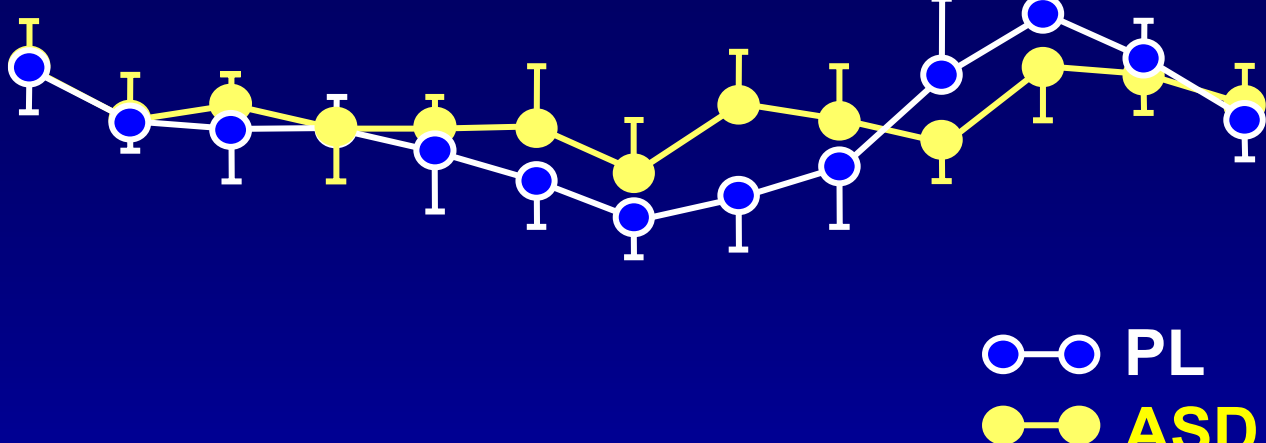


Extra Acute Data

LH (mIU/ml)

7
6
5
4
3
2
1
0

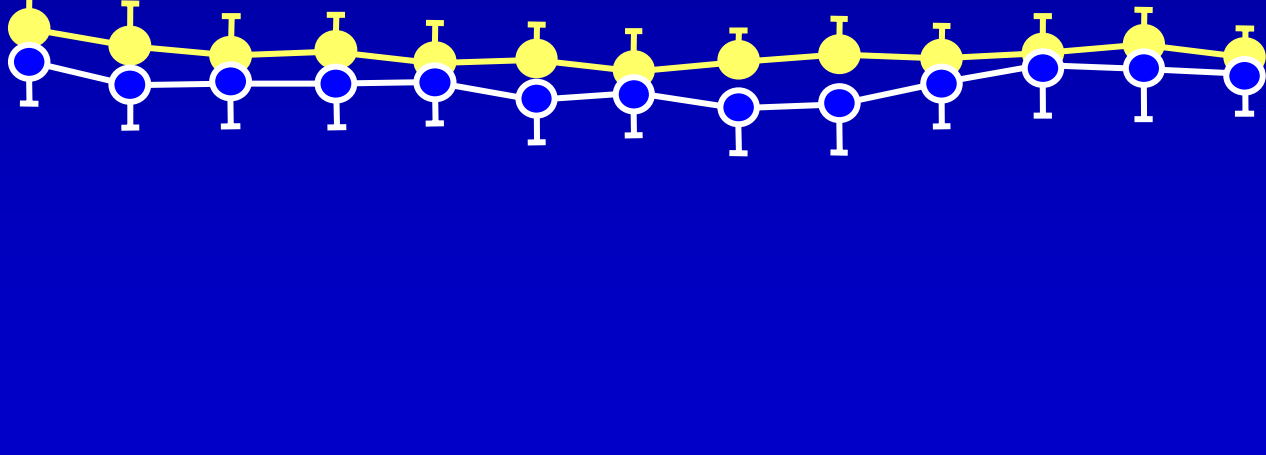
○—○ PL
●—● ASD



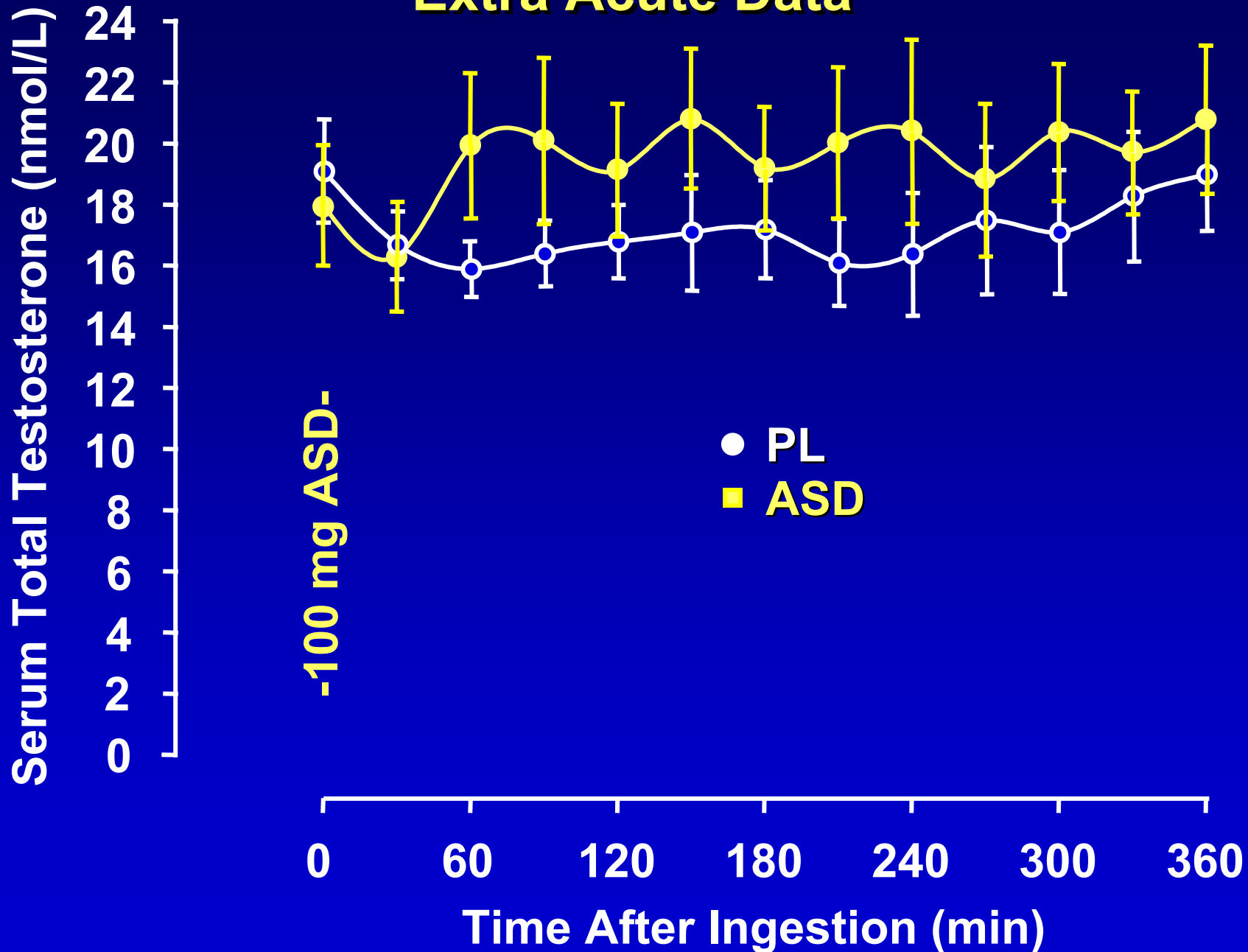
(FSH mIU/ml)

7
6
5
4
3
2
1
0

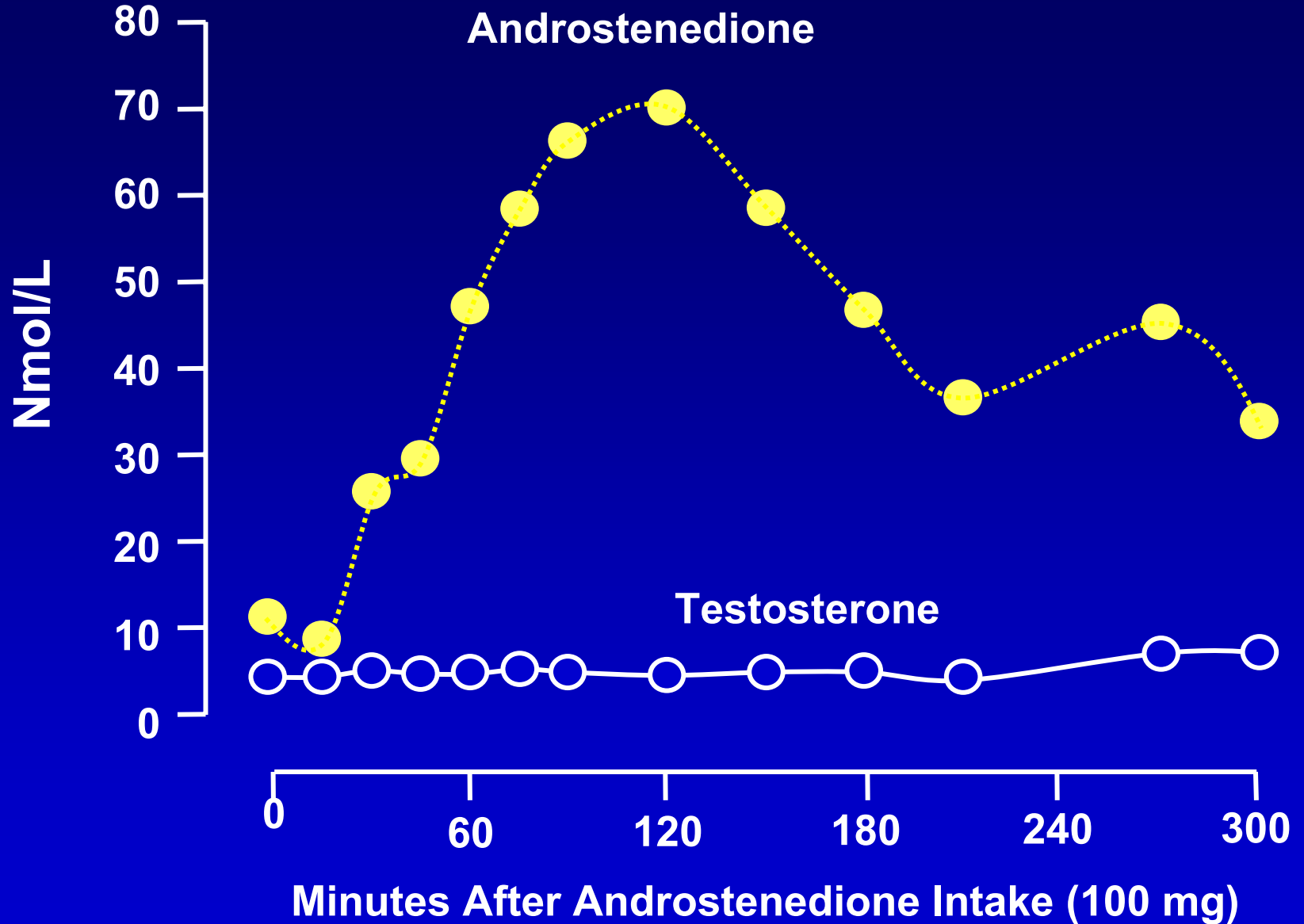
0 60 120 180 240 300 360
Time After Ingestion (min)



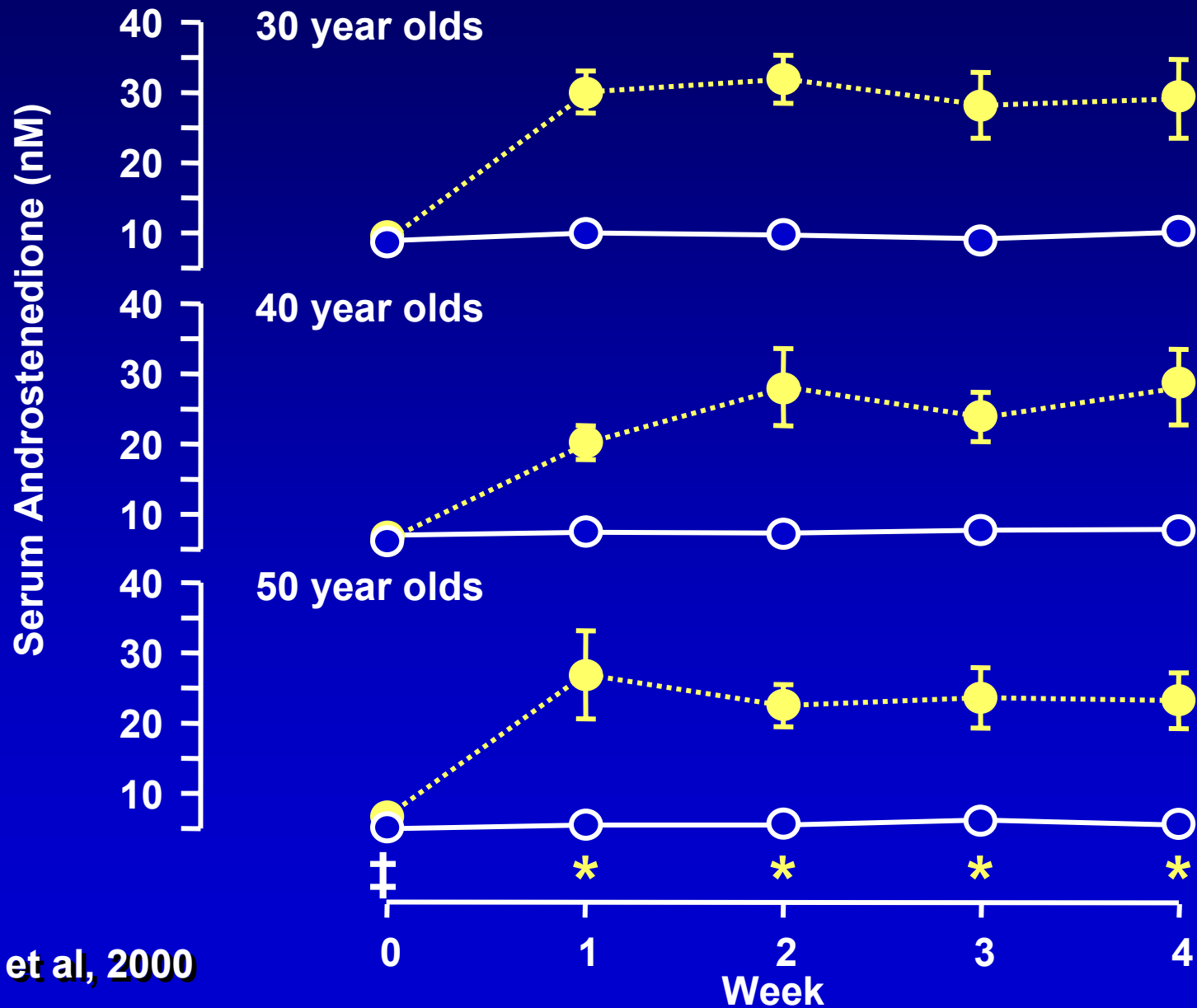
Extra Acute Data



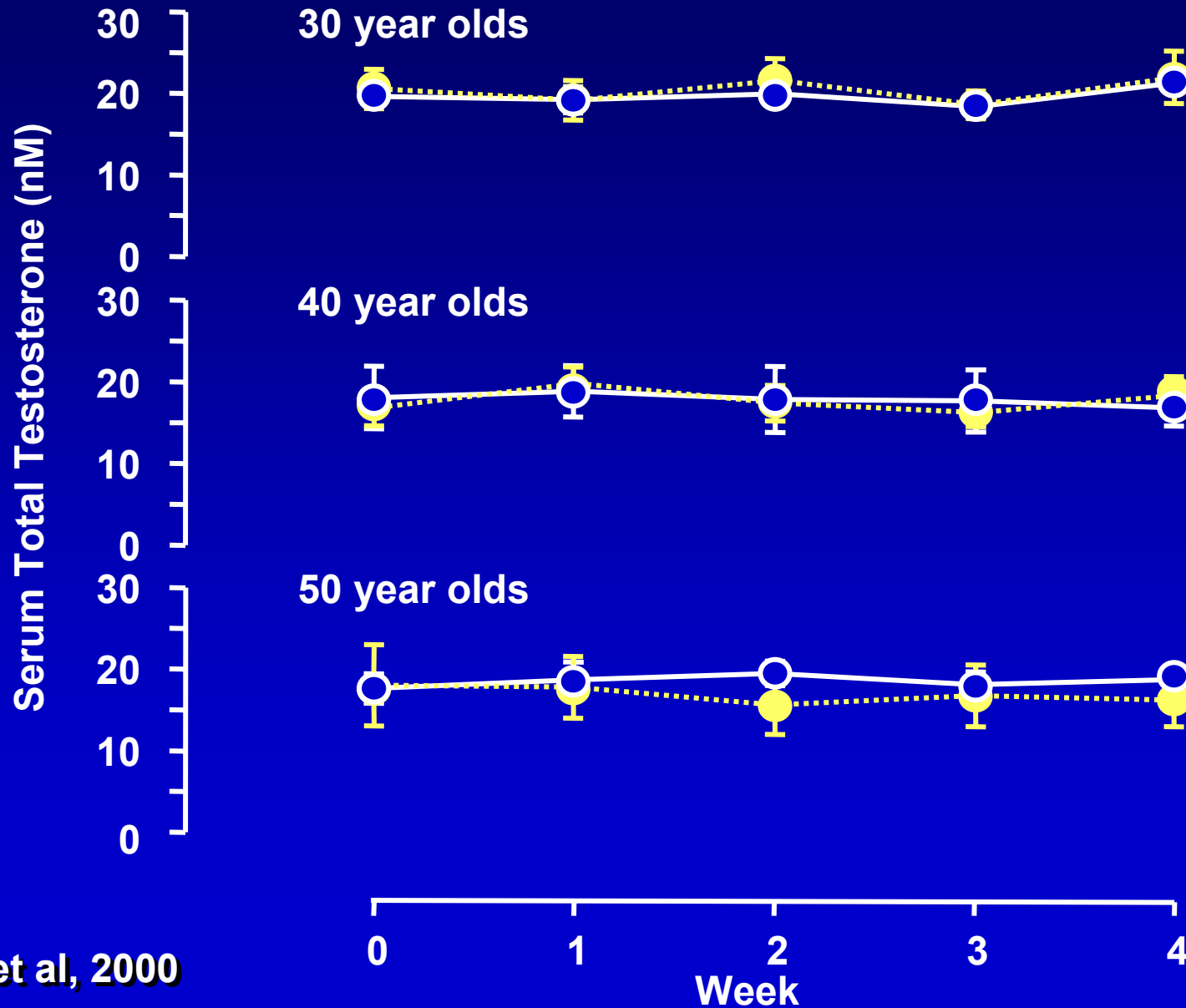
Extra Supporting Acute Data



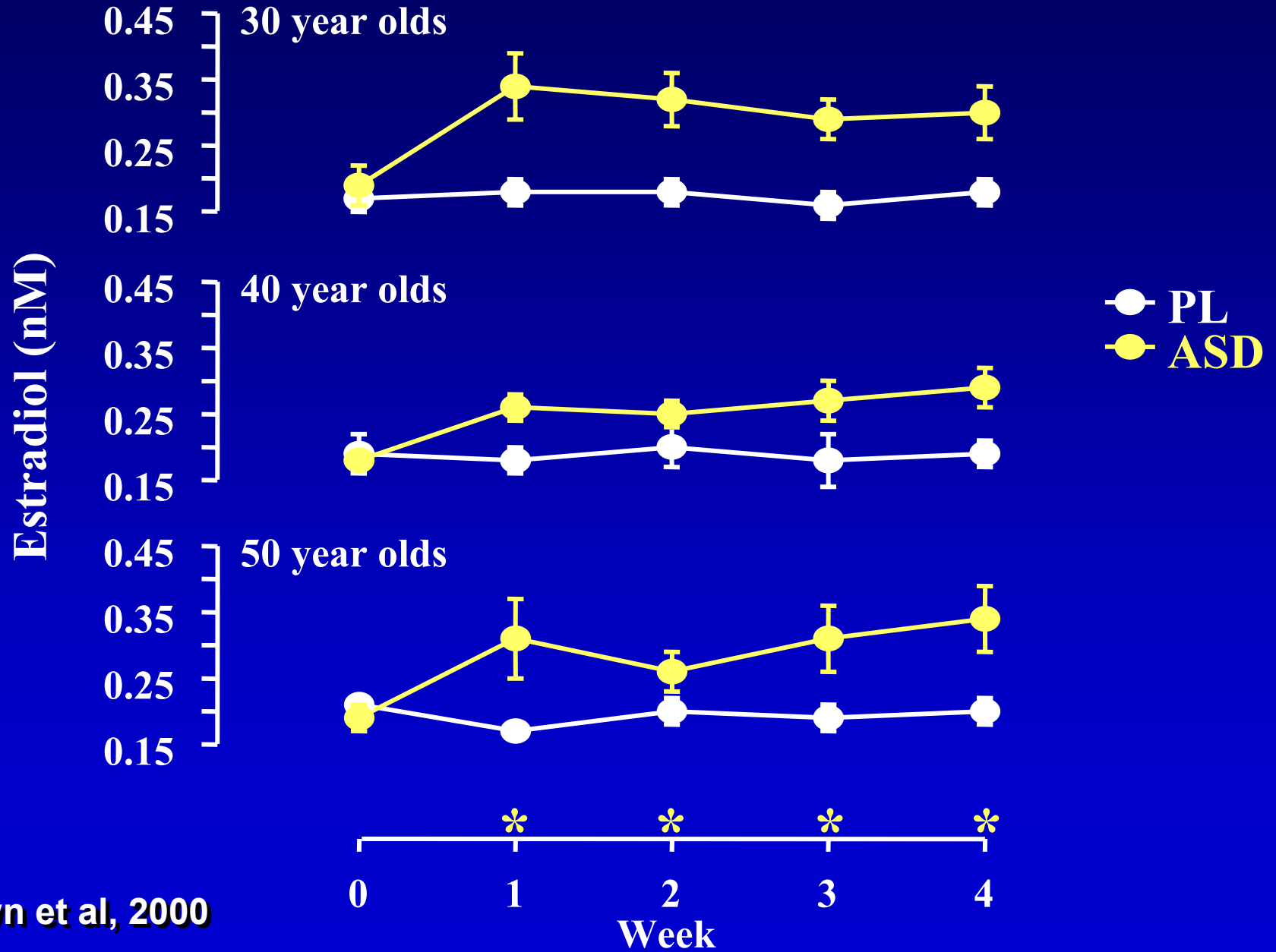
Extra 100 mg androstenedione t.i.d. in different ages



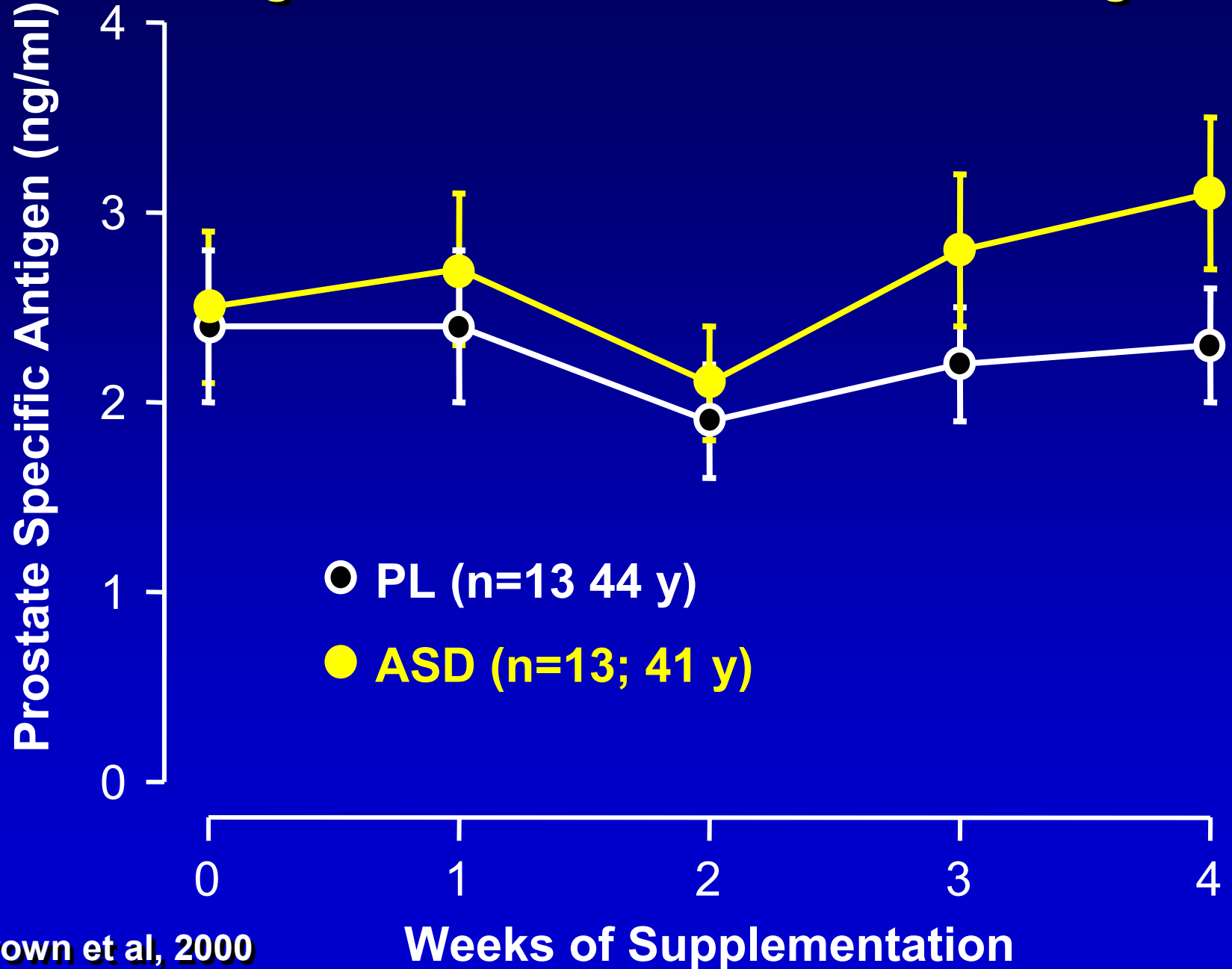
Extra 100 mg androstenedione t.i.d. in different ages



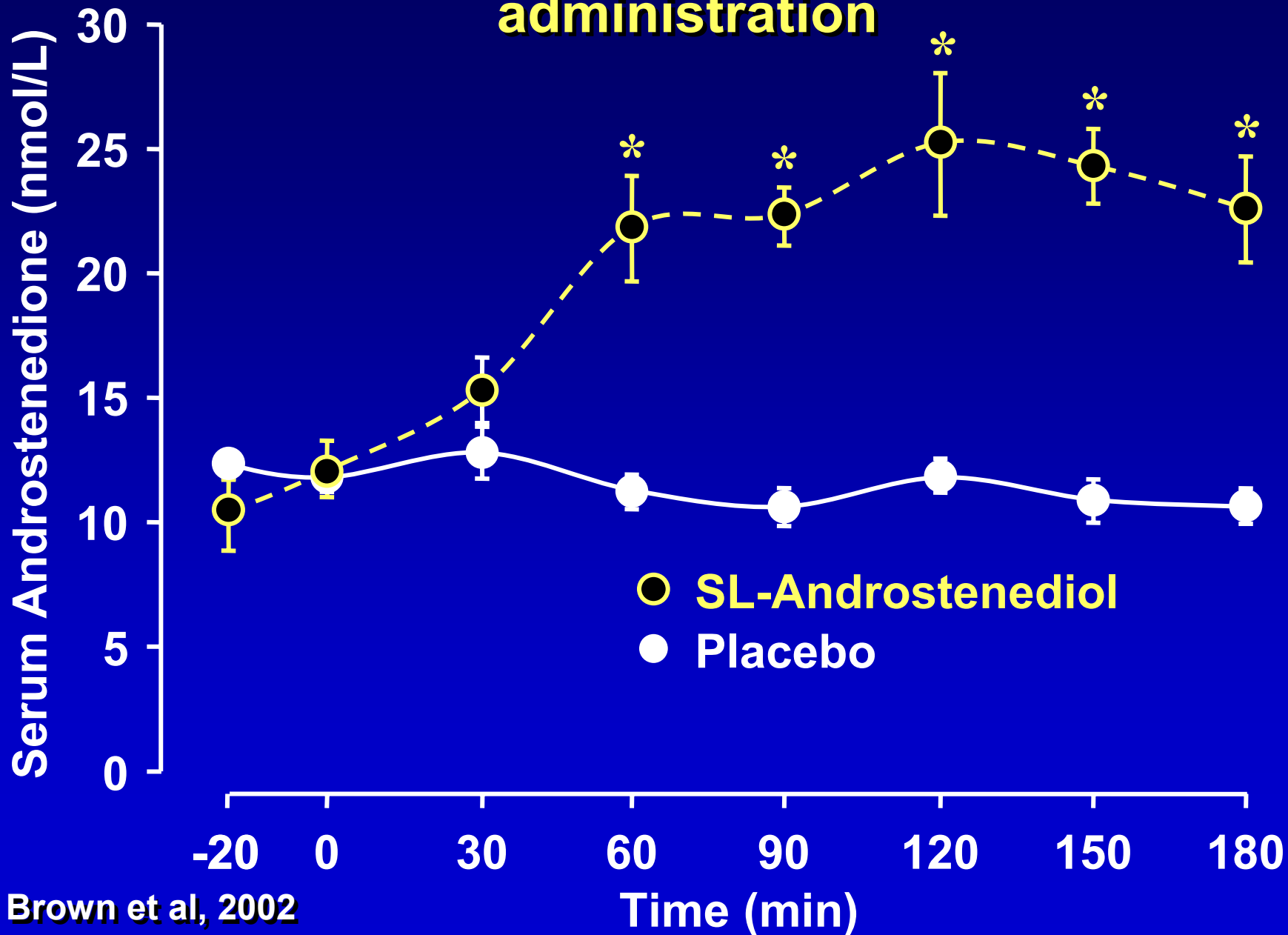
Extra 100 mg androstenedione t.i.d. in different ages



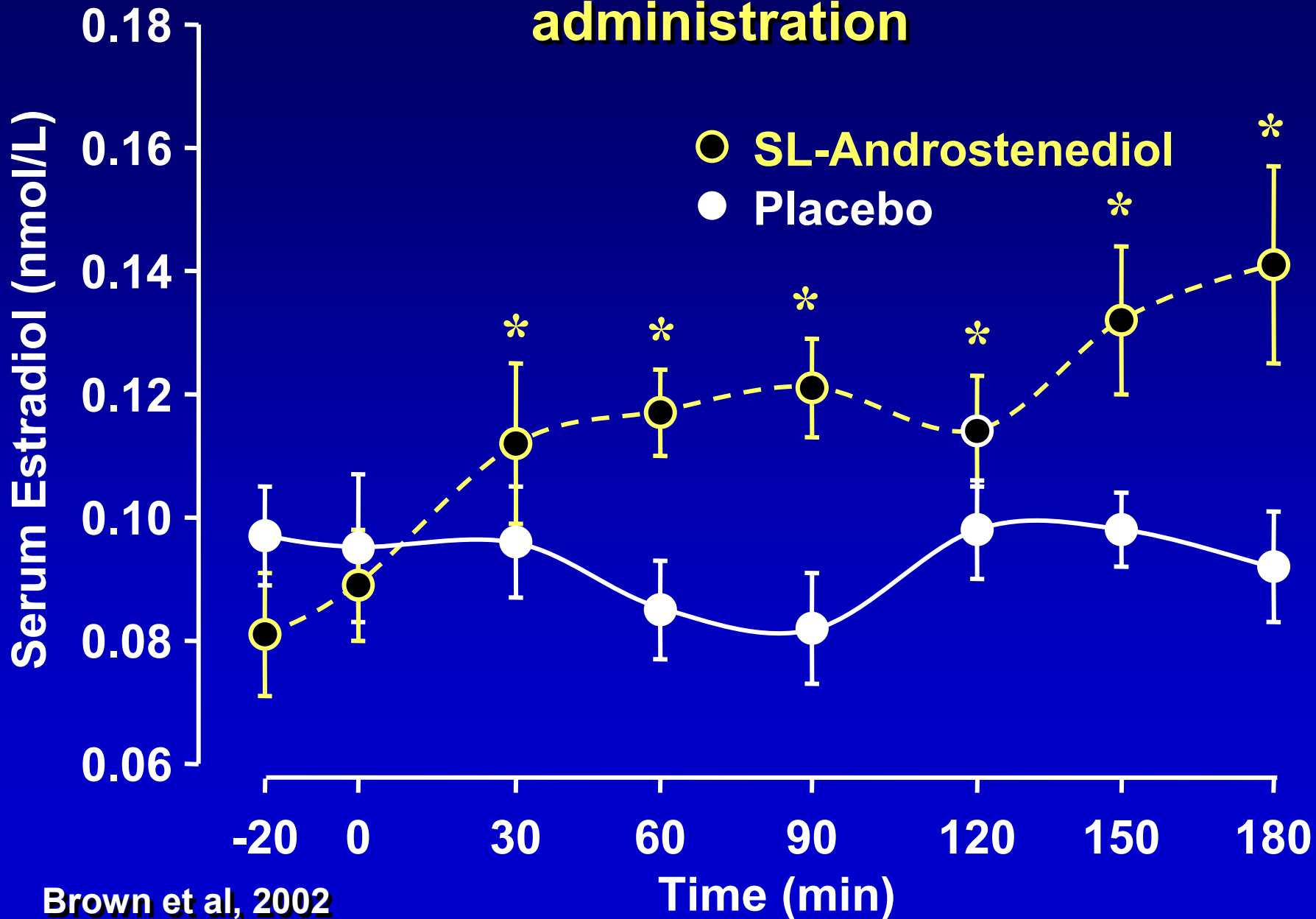
Extra 100 mg androstenedione t.i.d. in different ages



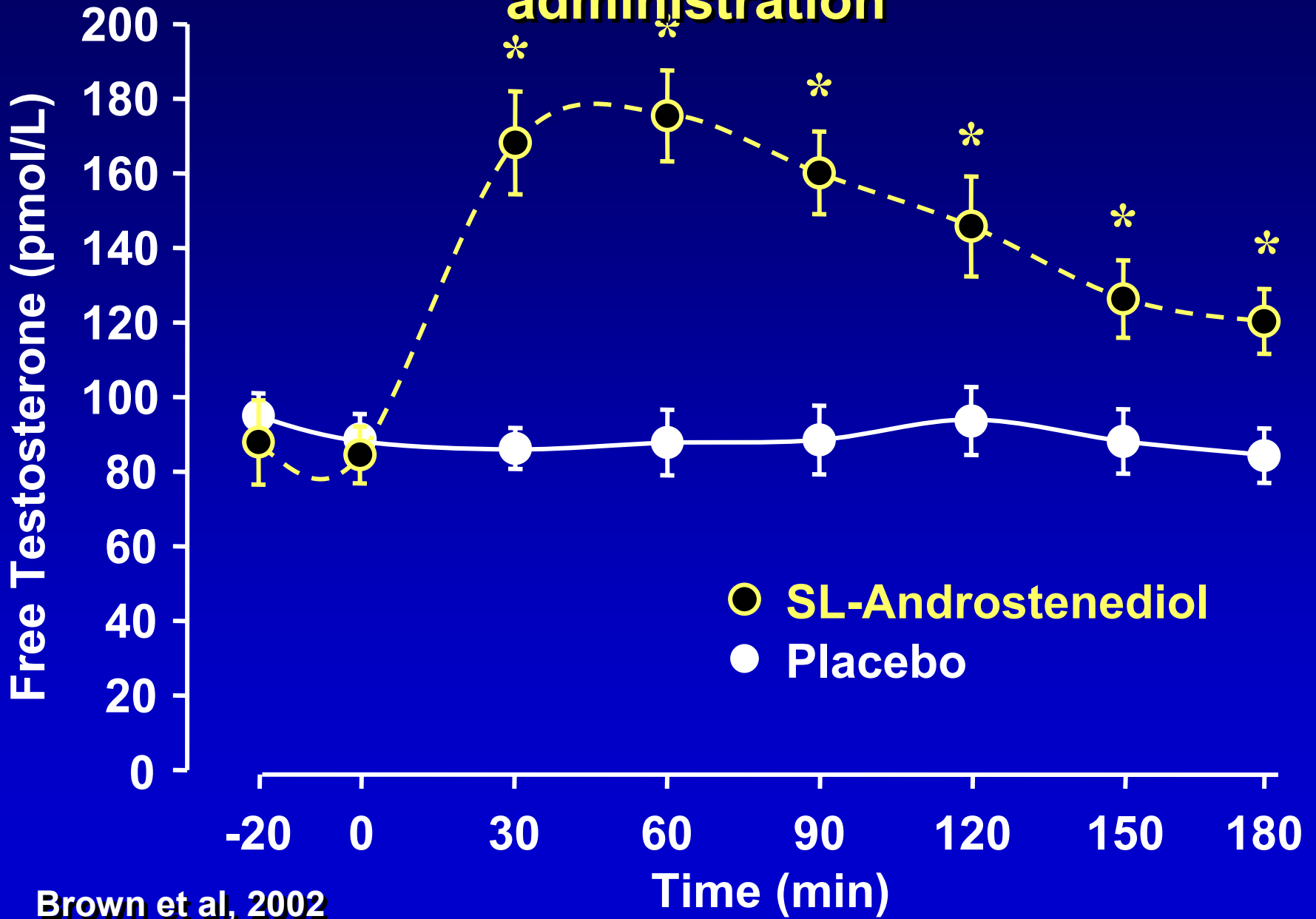
Extra 20mg sublingual cyclodextrin androstenediol administration



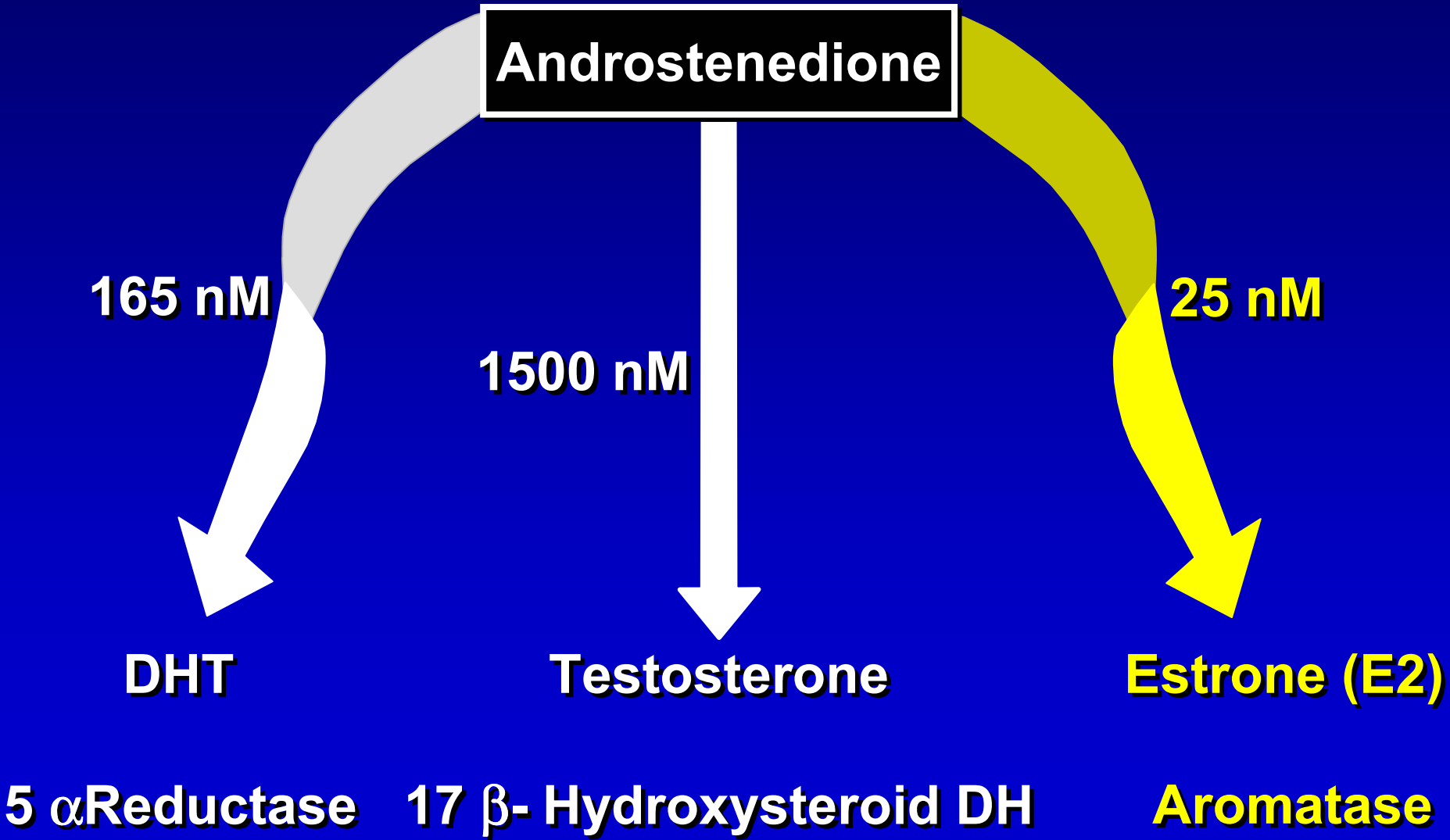
Extra 20mg sublingual cyclodextrin androstenediol administration



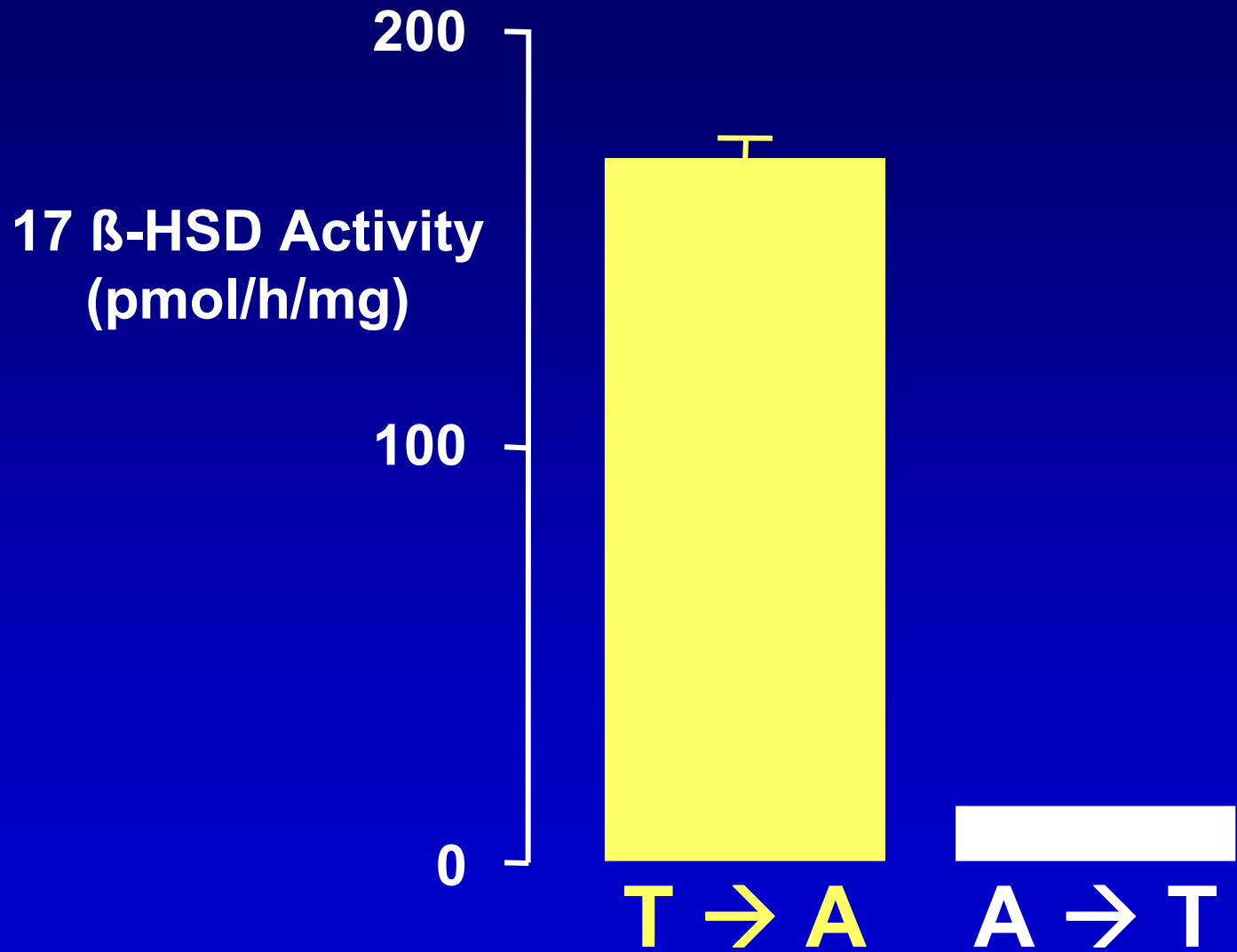
Extra 20mg sublingual cyclodextrin androstenediol administration



Michaelis Constants for Enzymes Catalyzing Conversion of Androstenedione to Other Steroids



A:T Conversions by Testicular Microsomes



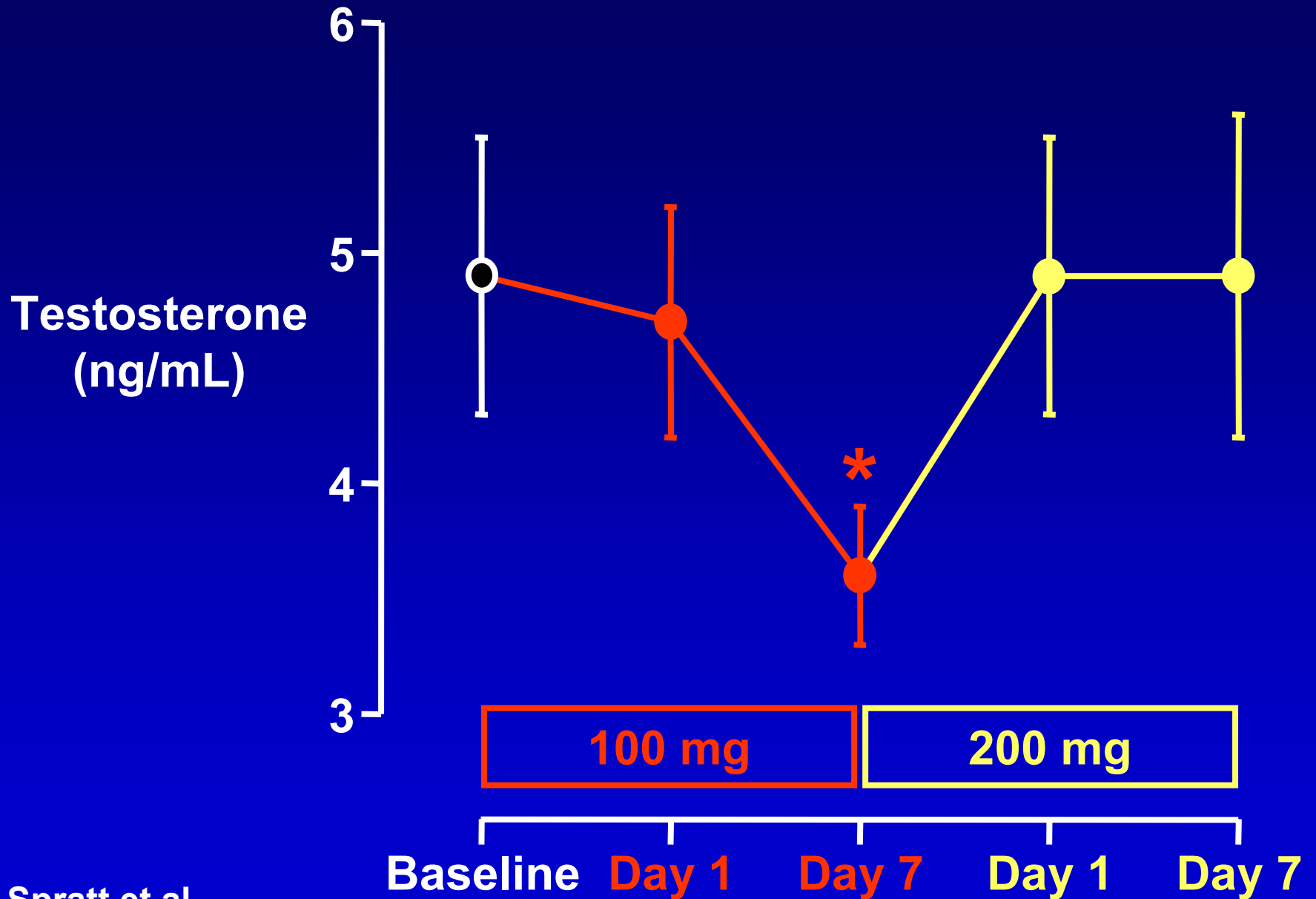
Evidence that Oral Androstenedione Increases Serum Testosterone

Authors	Subjects	Dose	[Testosterone]
Mahesh & Greenblatt	2 Women	100 mg	↑ 500%
Hacker & Mattern	???	???	↑ 237%
Earnest et al, 1999	8 men, 24 y	200 mg	↑ 15-20%

Evidence that Oral Androstenedione Does Not Increase Serum Testosterone

Authors	Subjects	Dose	[Testosterone]
King et al, 1999	10 men, 23 y	100 mg 300 mg/day for 8 wk	↔ ↔
Rasmussen et al, 1999	6 men	100 mg	↔
Spratt et al, 1999	6 men	1 wk: 100 mg/d 1 wk: 200 mg/d	↓ 26% ↔
Ziegenfuss et al, 1998	7 men, 28 y	100 mg	↔

Effect of 100- and 200 mg Androstenedione in 6 Healthy me

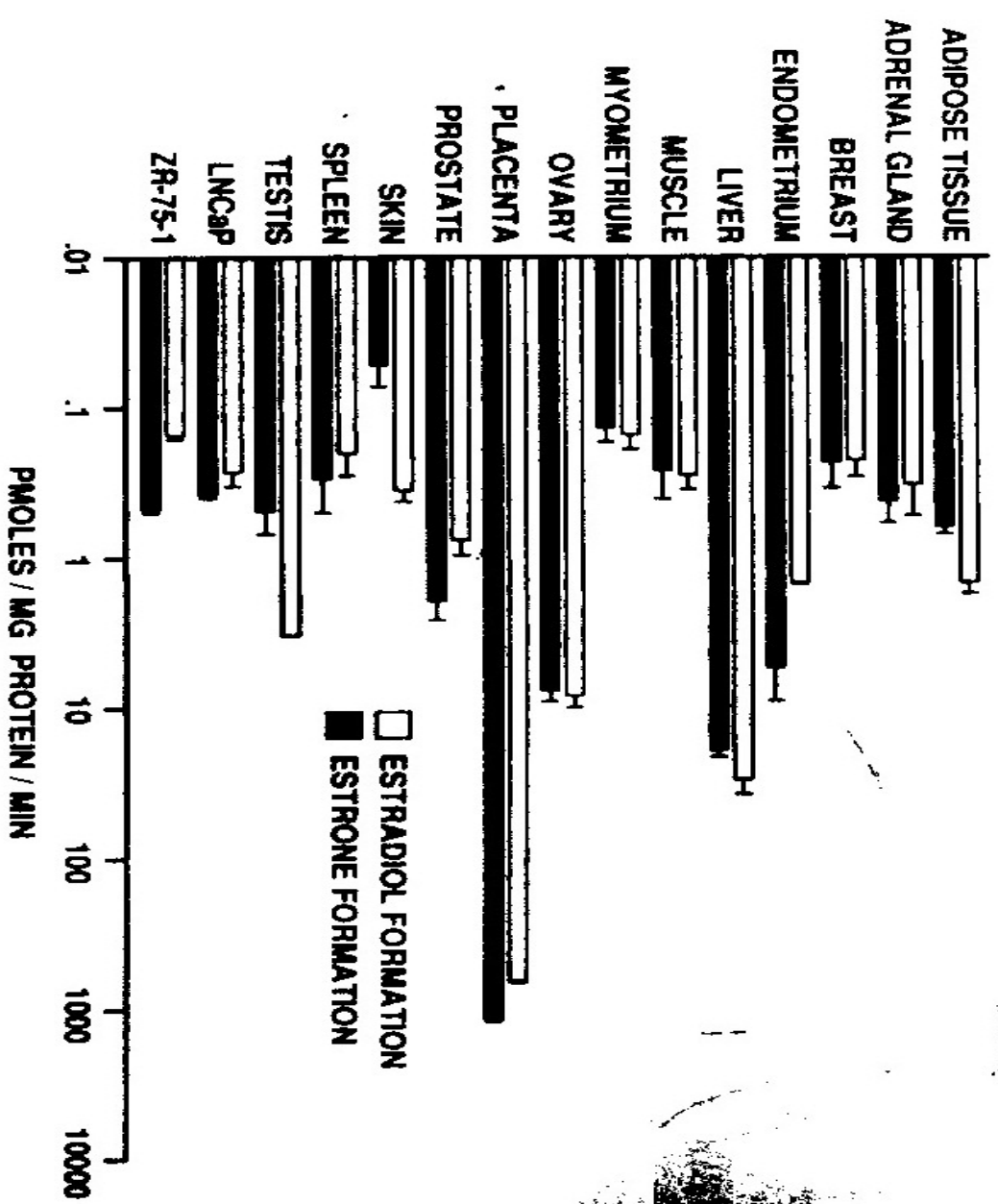


Spratt et al,
The Endocrine Society, 1999.

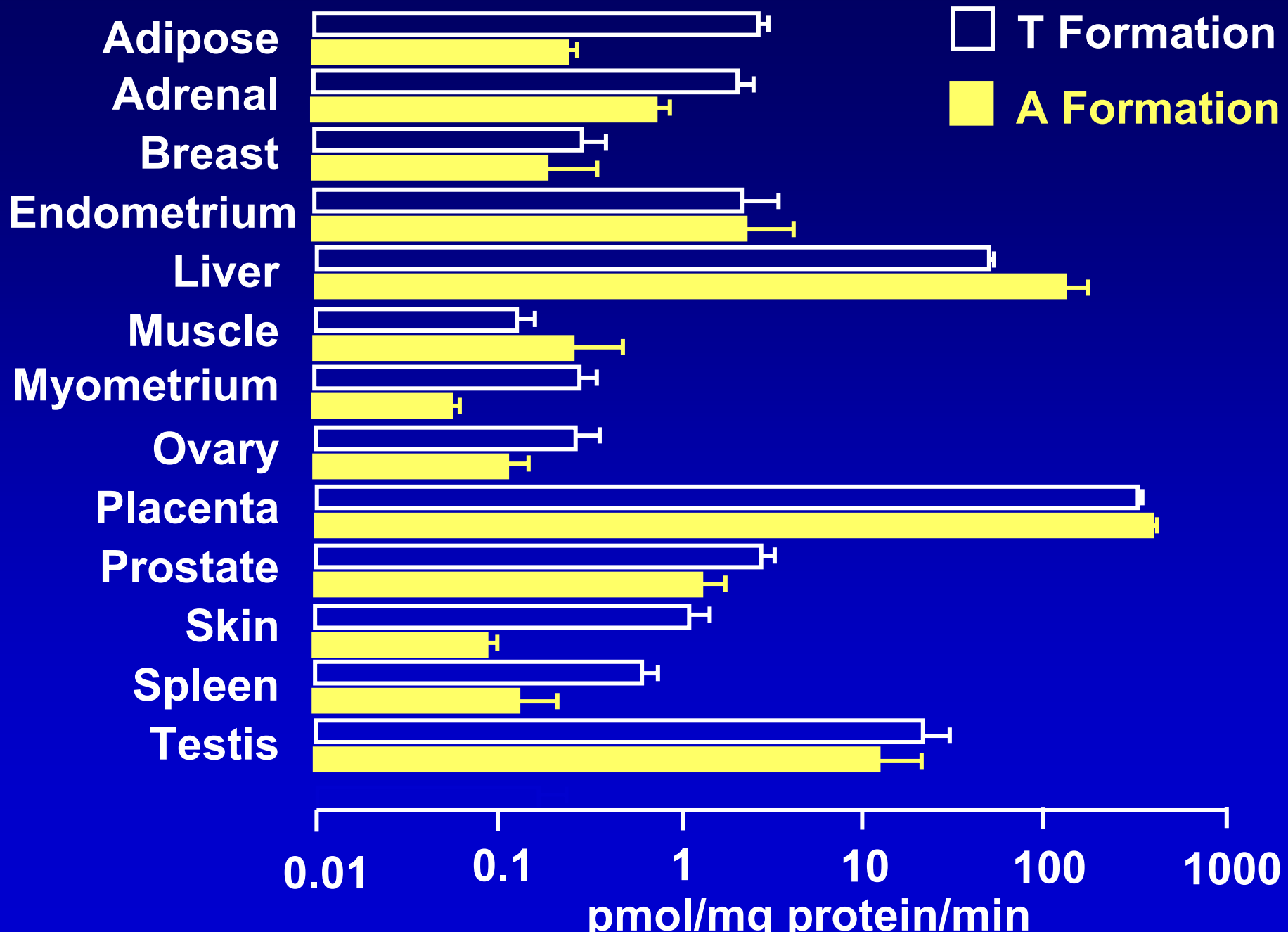
HUMAN TISSUE

ESTROGENIC 17 β -HSD ACTIVITY

A



Androgenic 17 β -HSD Activity In Human Tissue



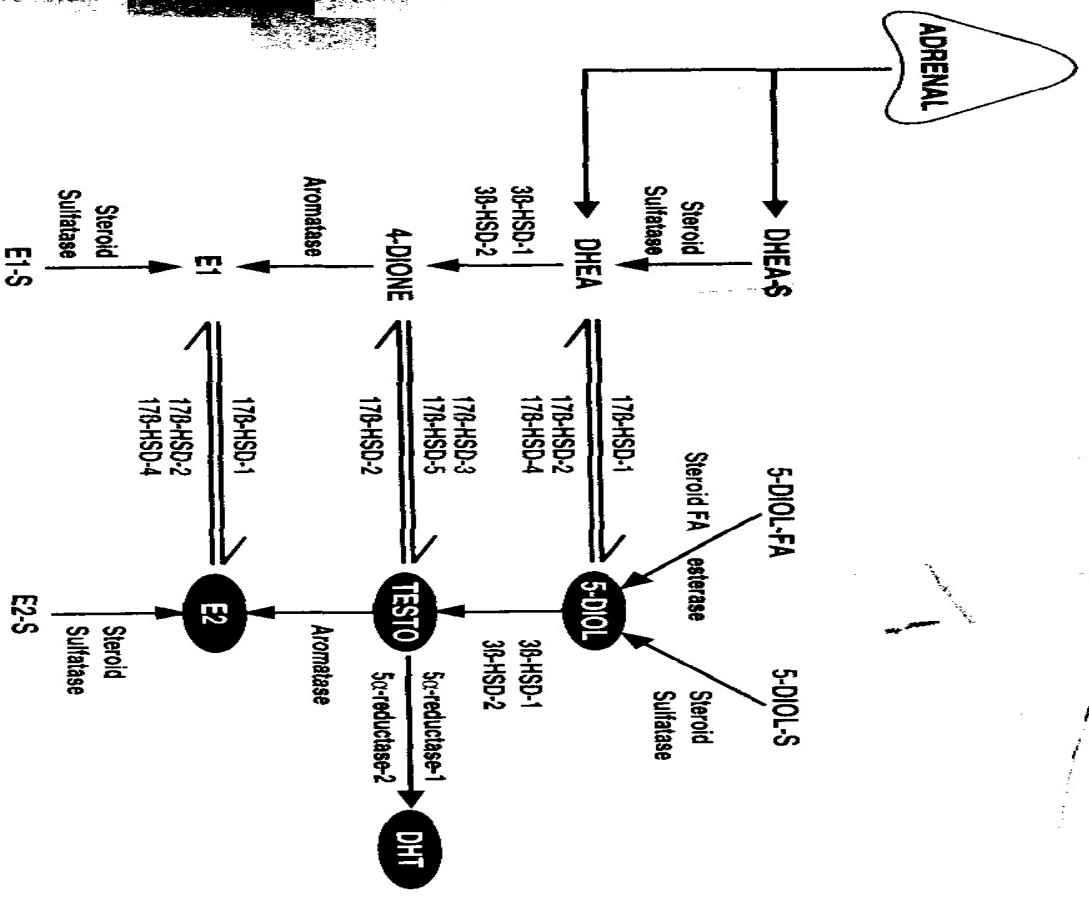


Figure 1 Human steroidogenic enzymes in peripheral intracrine tissues.