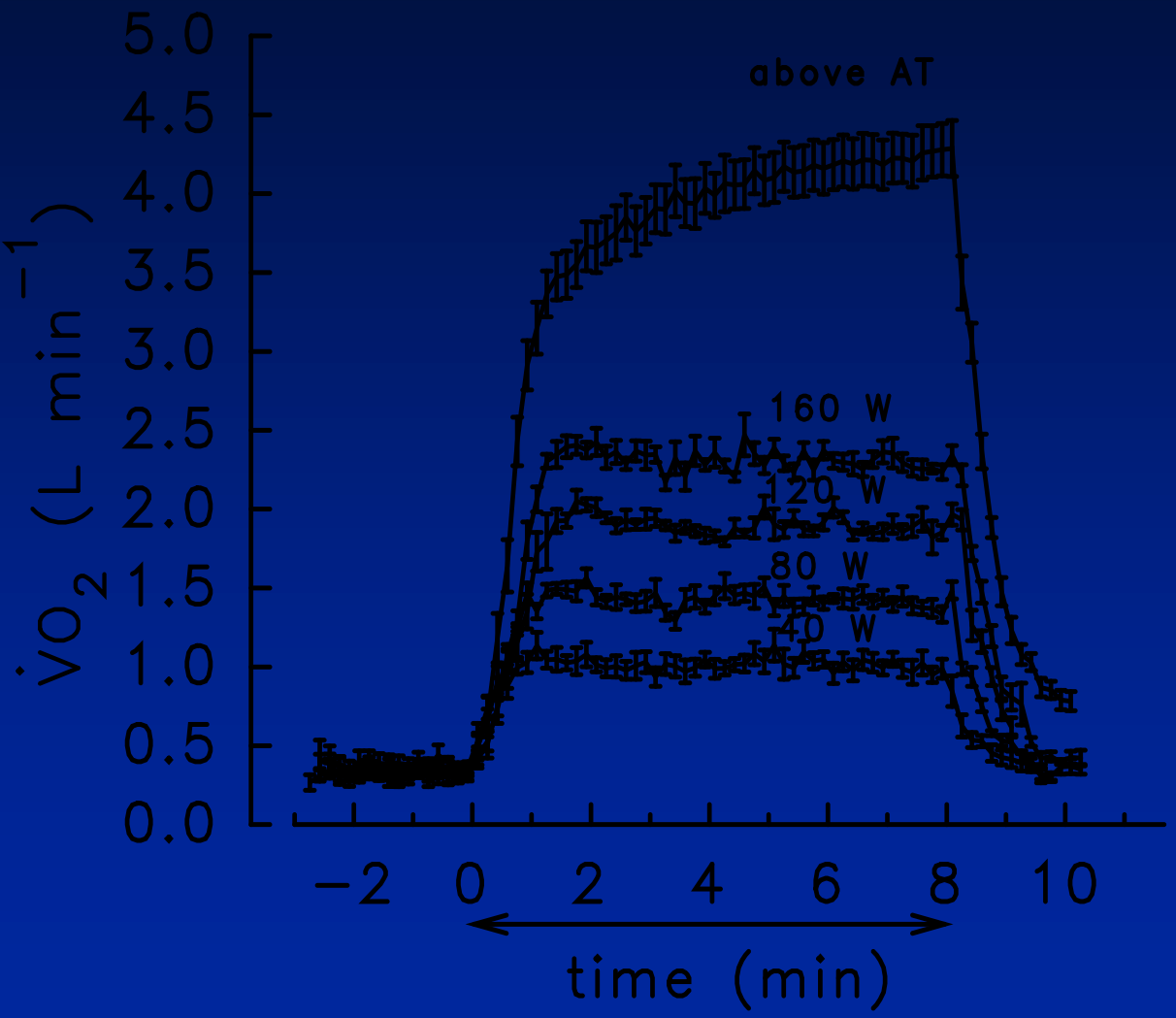
Constant Work Rate Testing

M.S. Riley

$\dot{V}O_2$



lactate (mM)

5.3

0.9

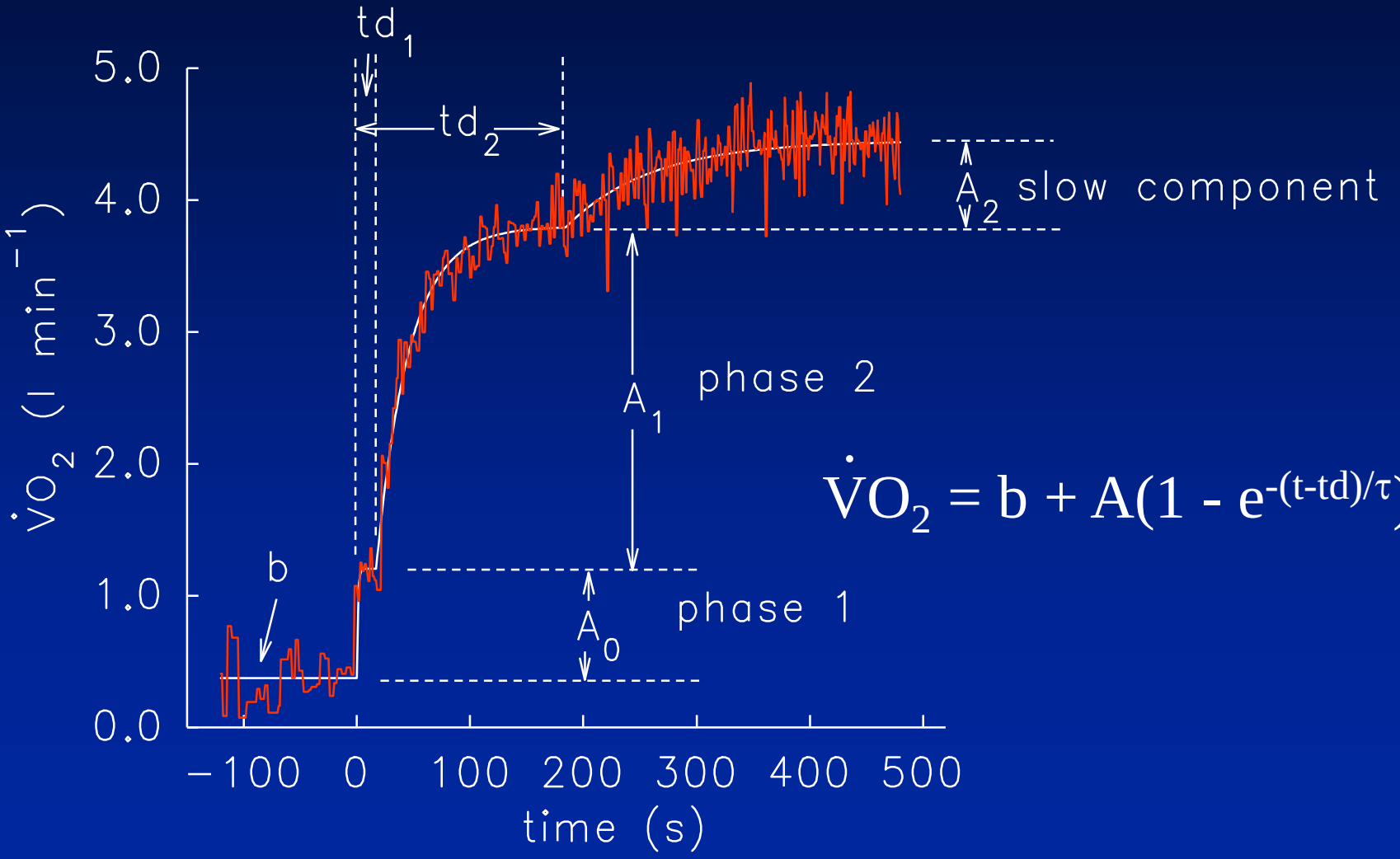
0.9

0.5

0.6

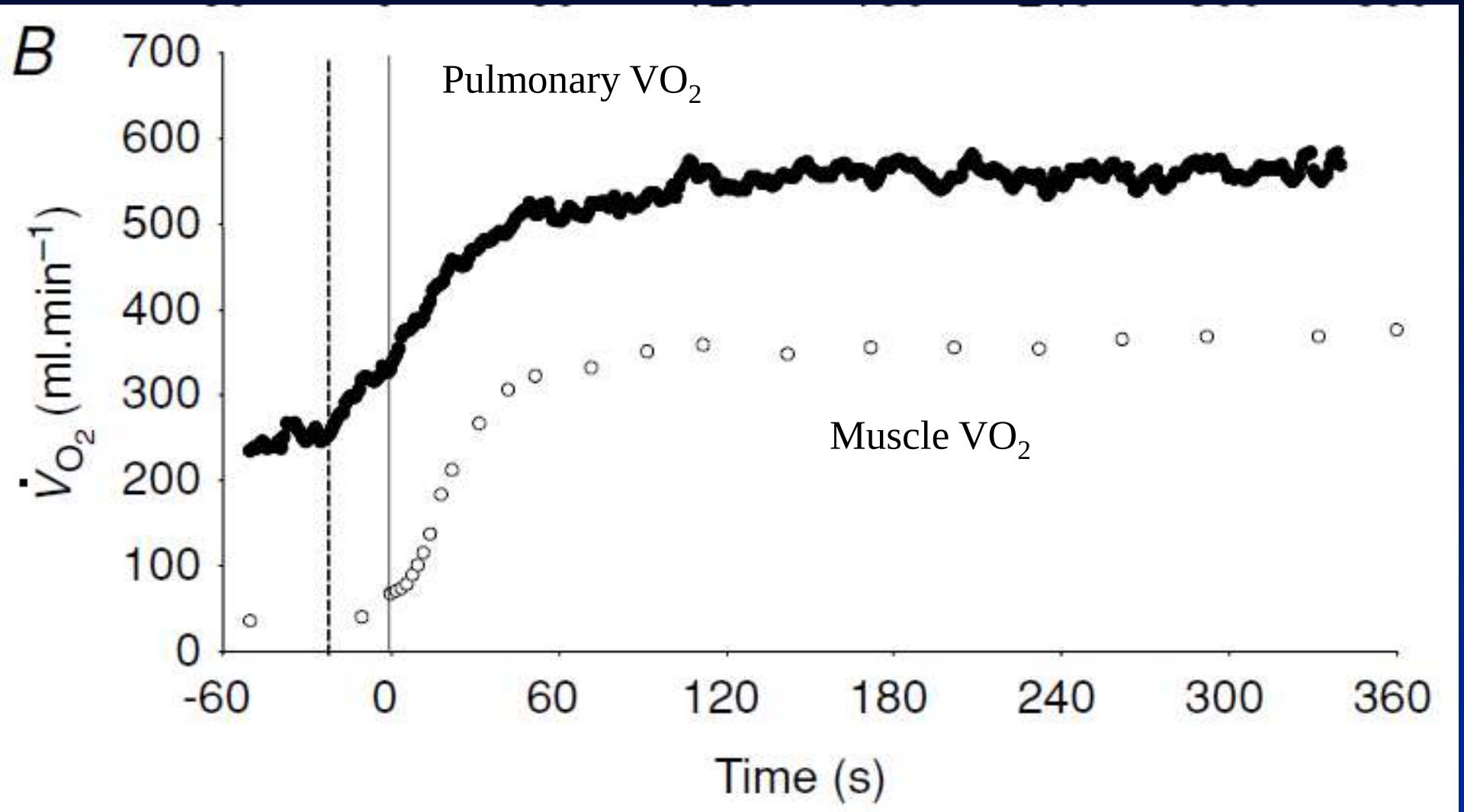
Riley et al. Med Sci Sports Exerc 2002

Components of response



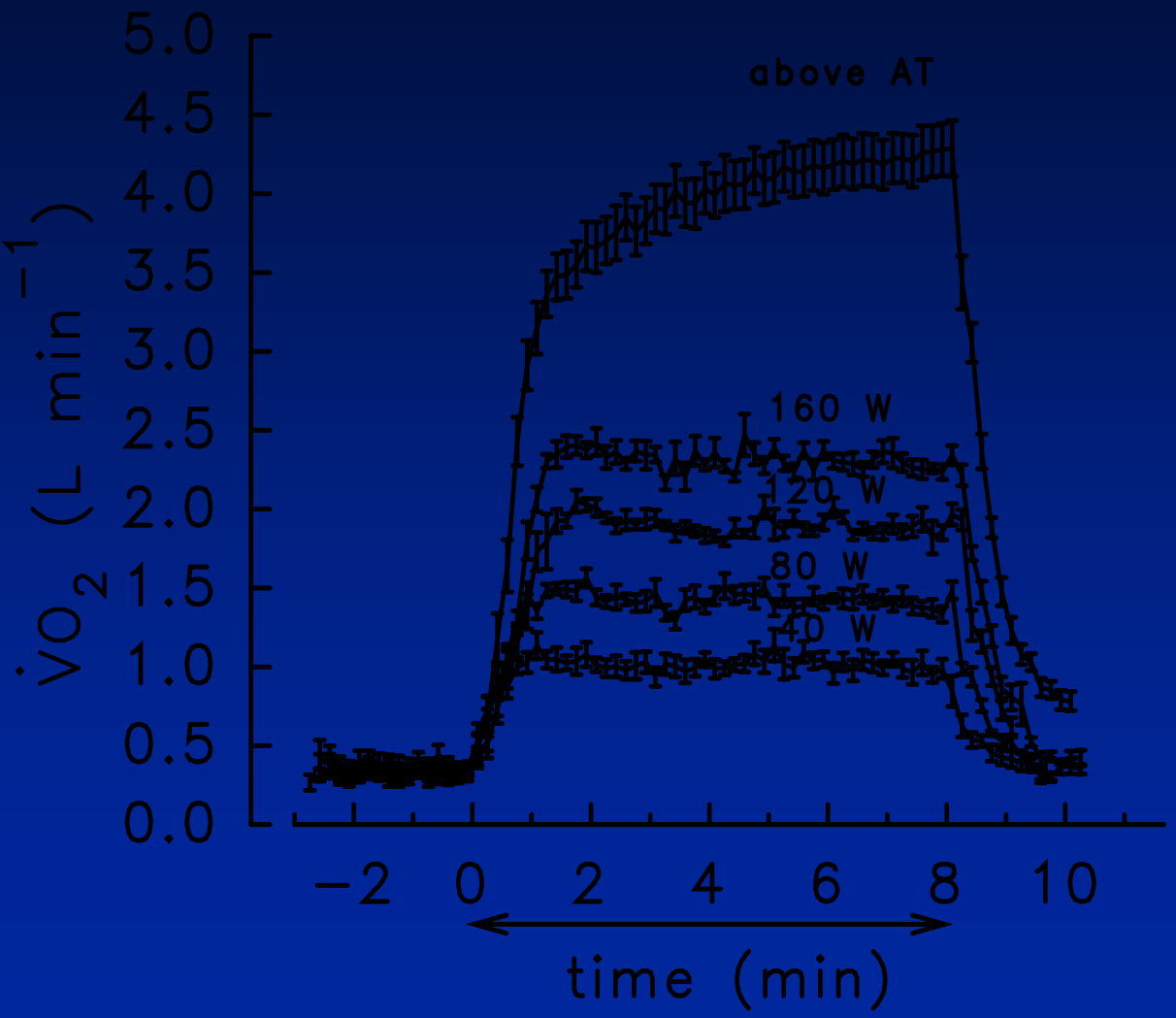
$$\dot{V}O_2 = b + A(1 - e^{-(t-td)/\tau})$$

Low intensity exercise



Krustrup et al. 2009

$\dot{V}O_2$



lactate (mM)

5.3

0.9

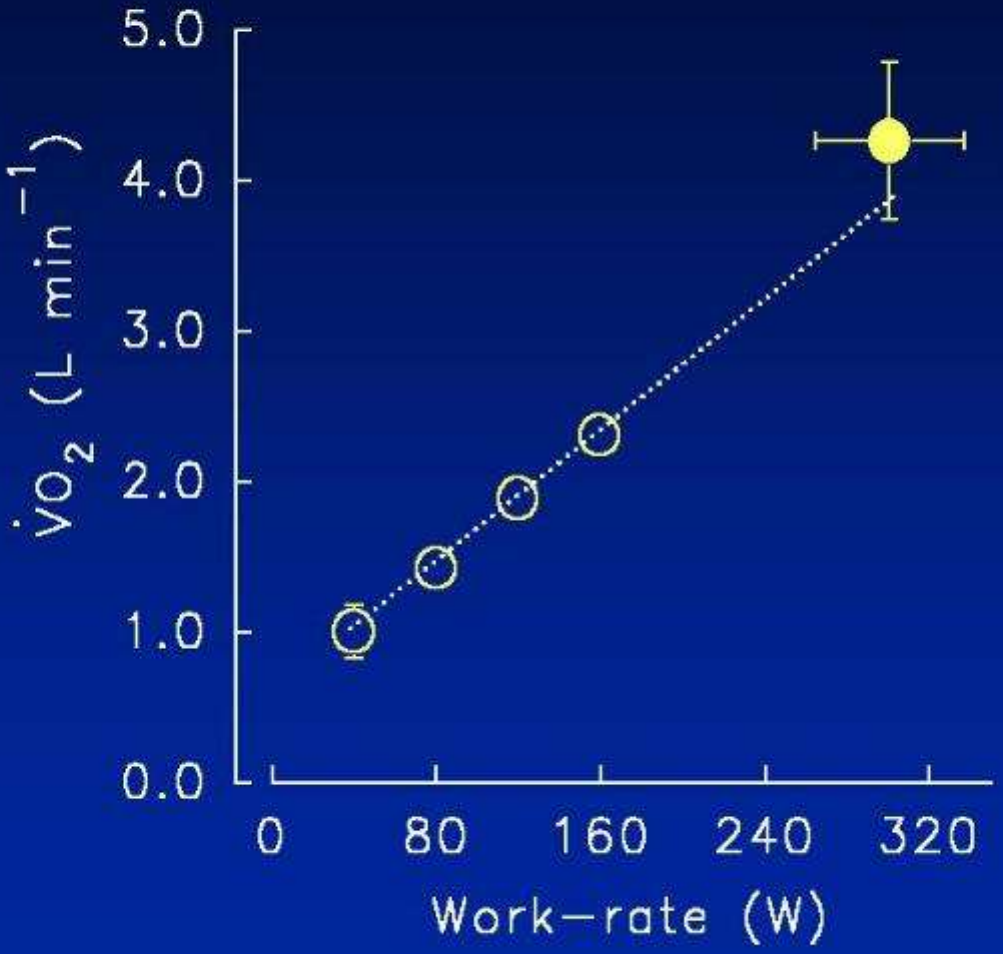
0.9

0.5

0.6

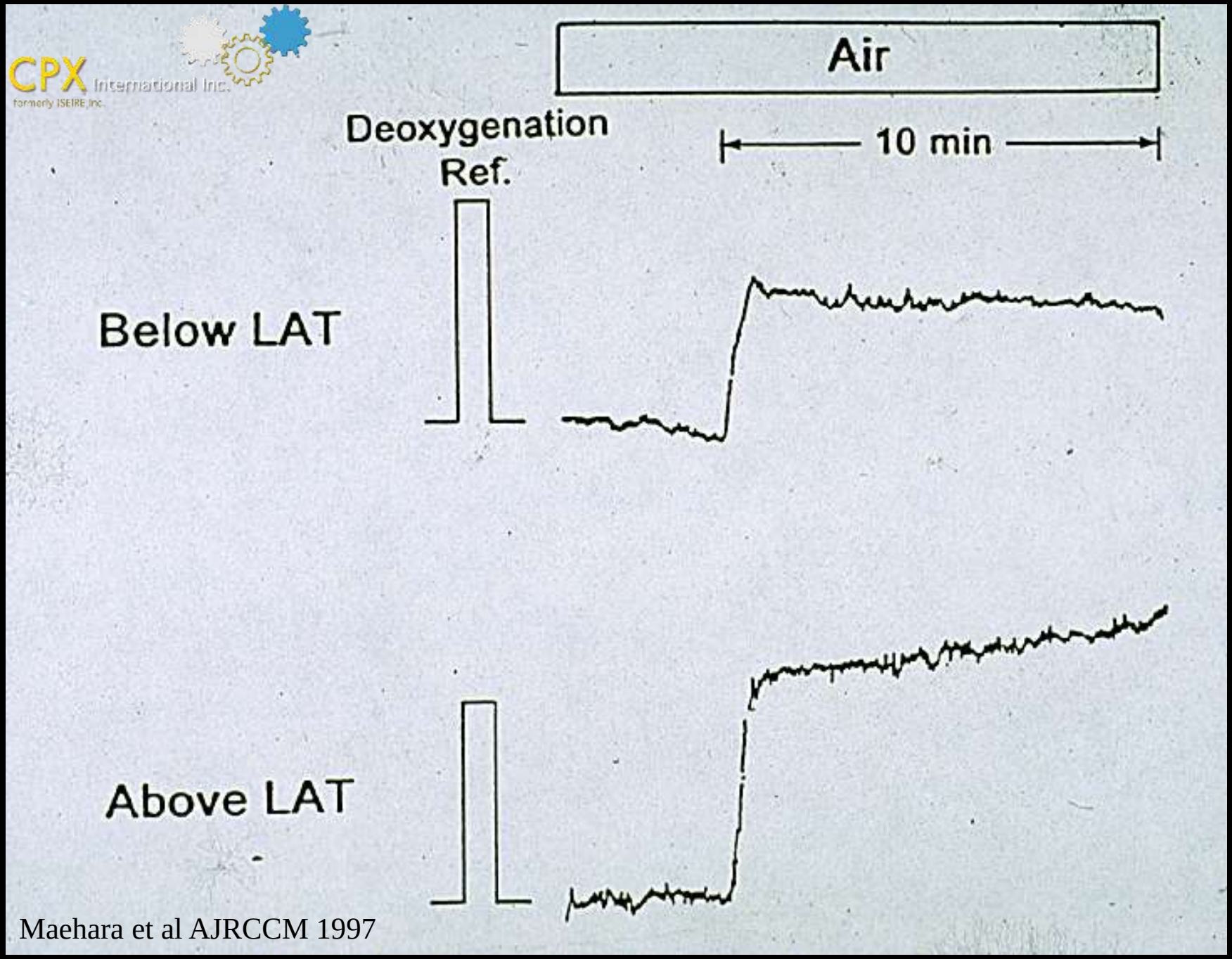
Riley et al. Med Sci Sports Exerc 2002

Constant WR $\dot{V}O_2$



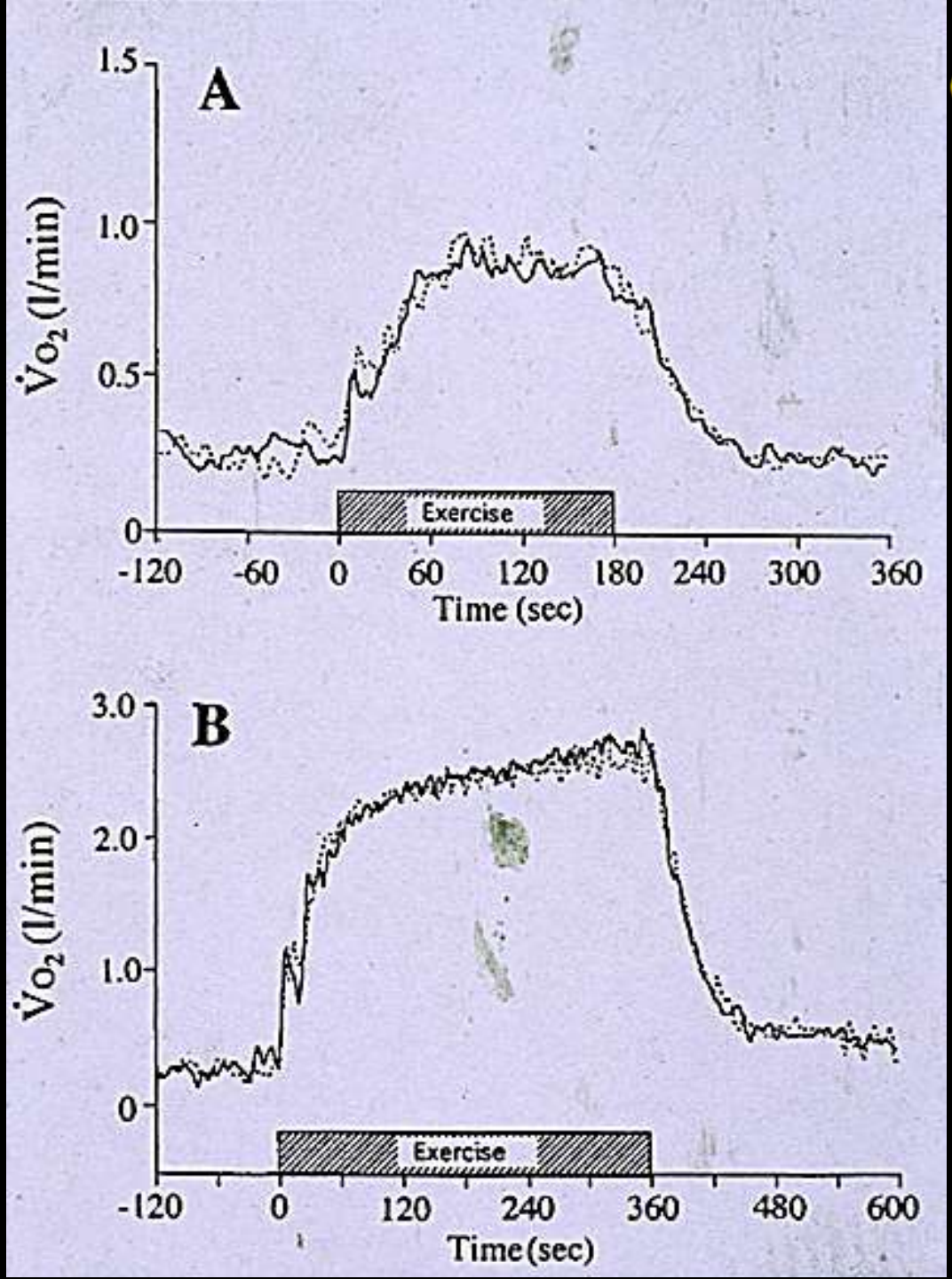
Riley et al. Med Sci Sports Exerc 2002

Mechanism of slow component?

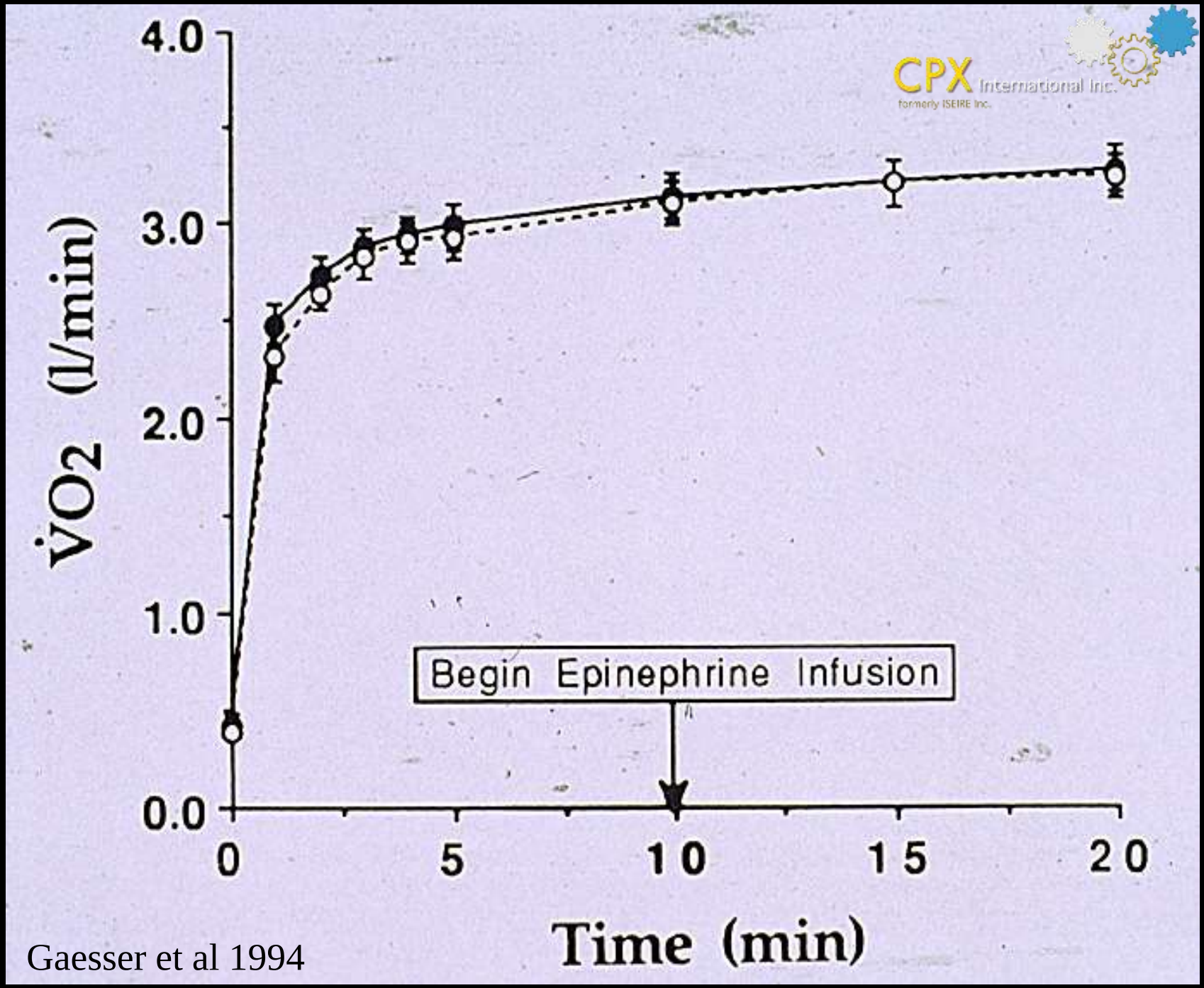


Maehara et al AJRCCM 1997

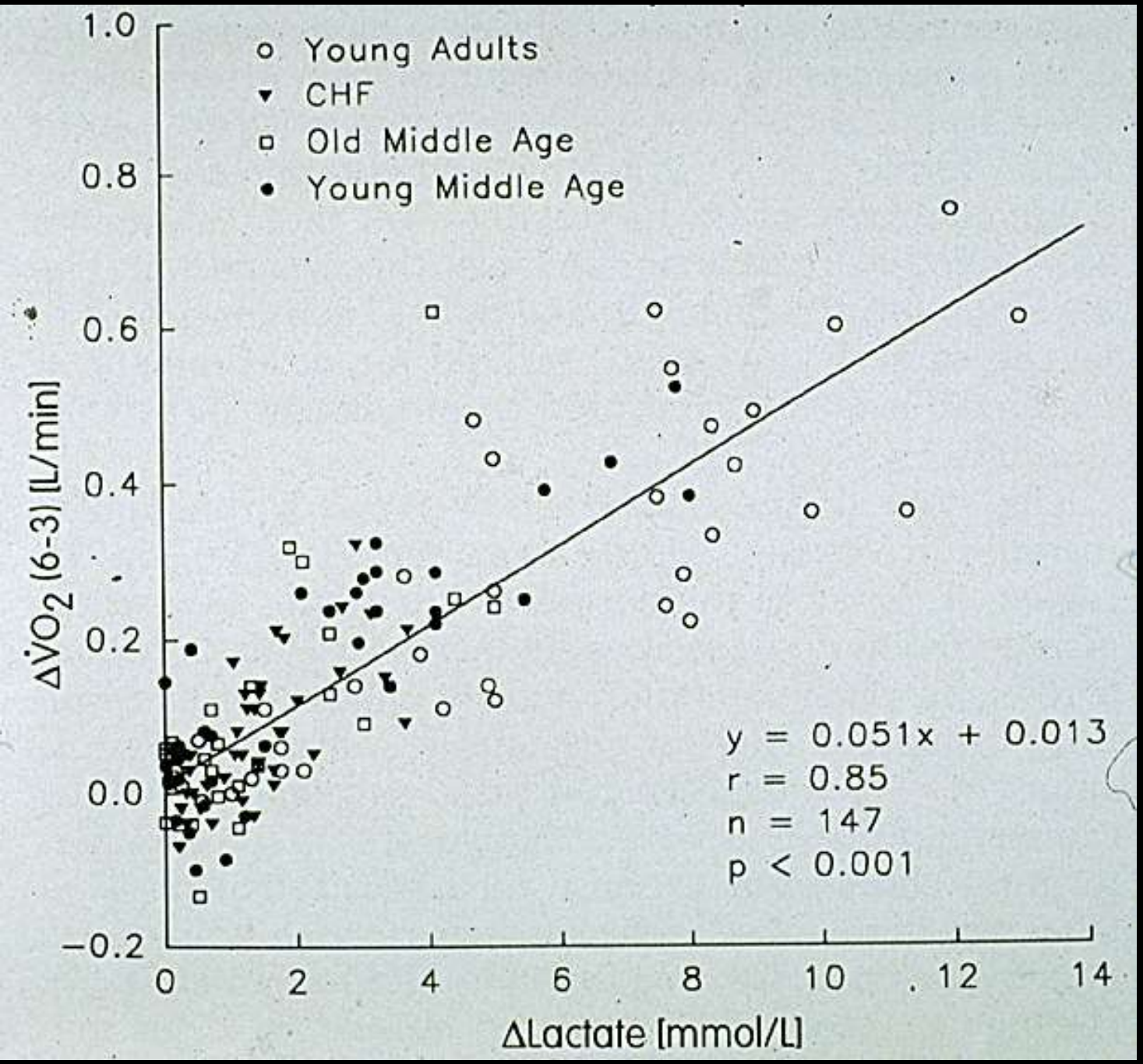
Q_{10}



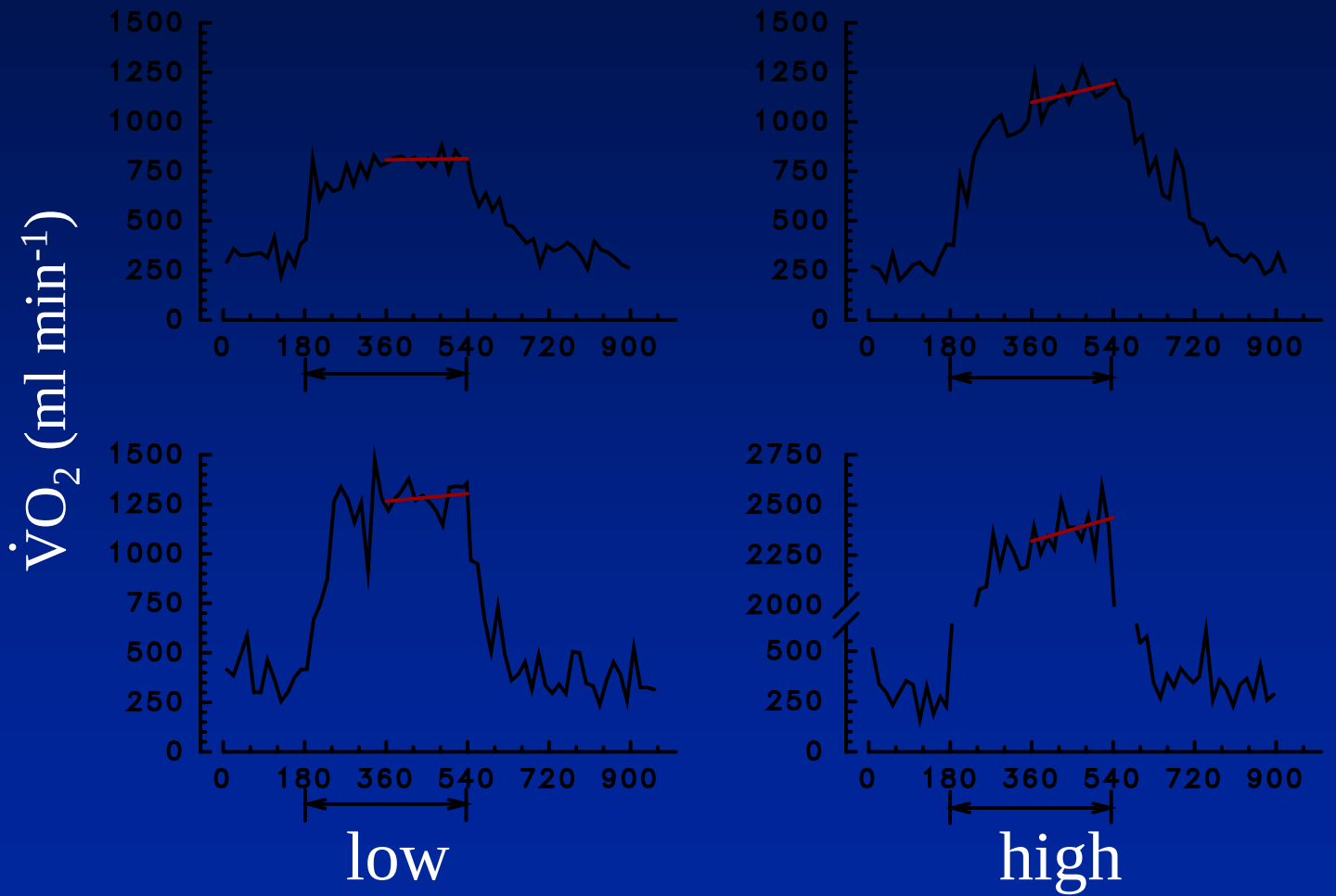
Koga et al. 1997



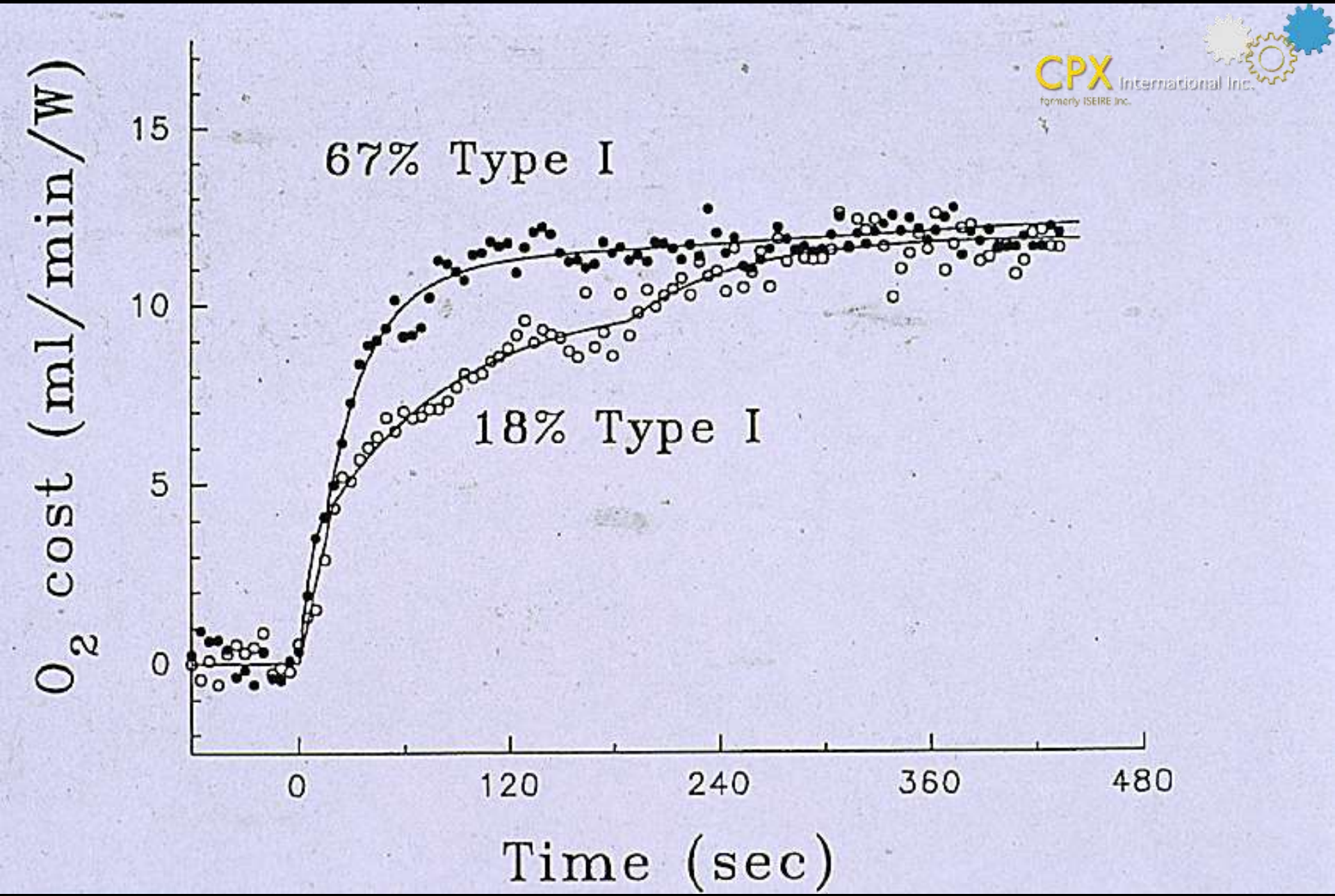
Gaesser et al 1994


Young Adults
CHF
Old Middle Age
Young Middle Age
y = 0.051x + 0.013
r = 0.85
n = 147
p < 0.001
ΔV̇O2 (6-3) [L/min]
ΔLactate [mmol/L]
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
0
2
4
6
8
10
12
14

$\dot{V}O_2$ in McArdle's Disease



Ong et al. AJRCCM 2004

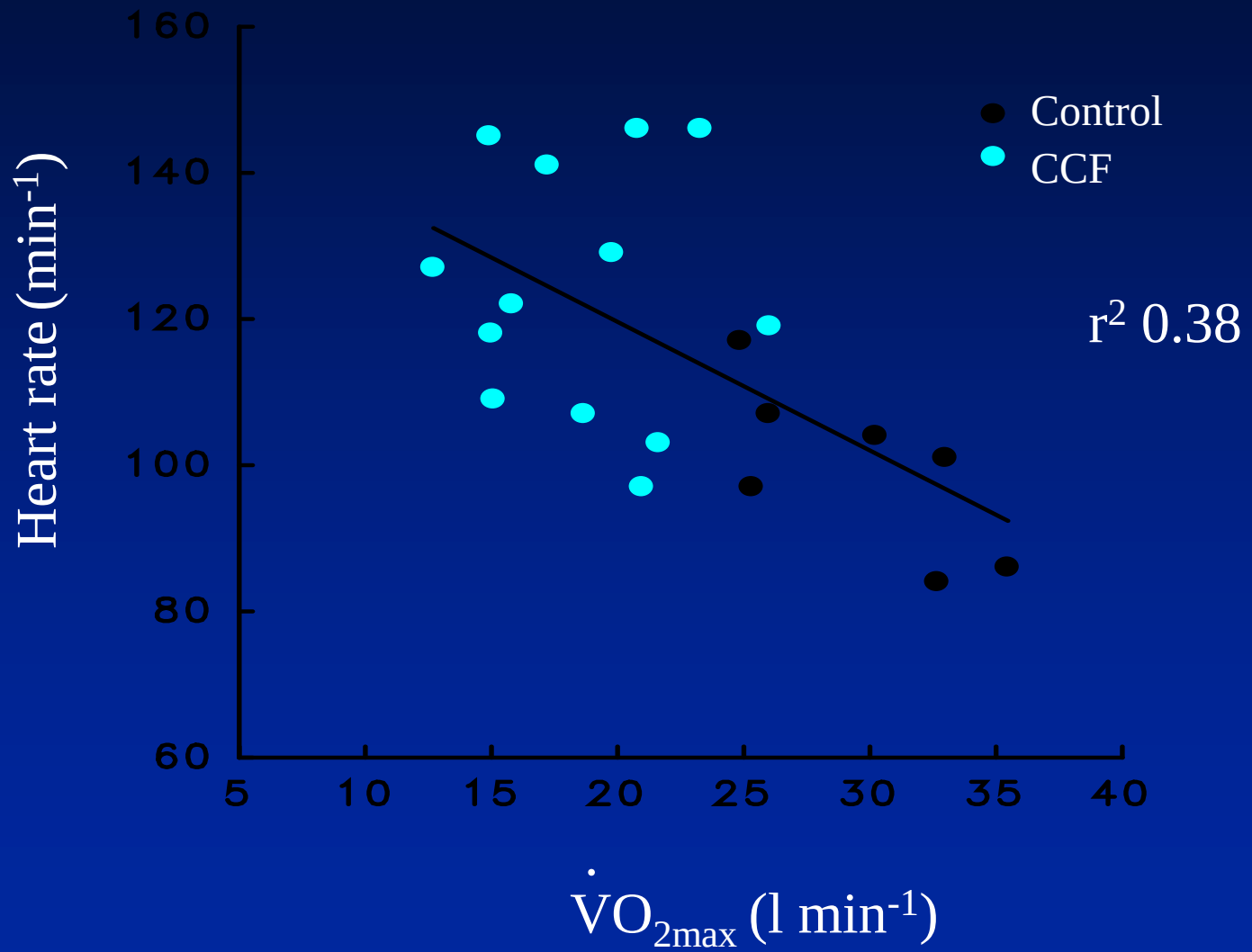


Barstow et al. 1996

What happens in disease?

End-exercise heart rate

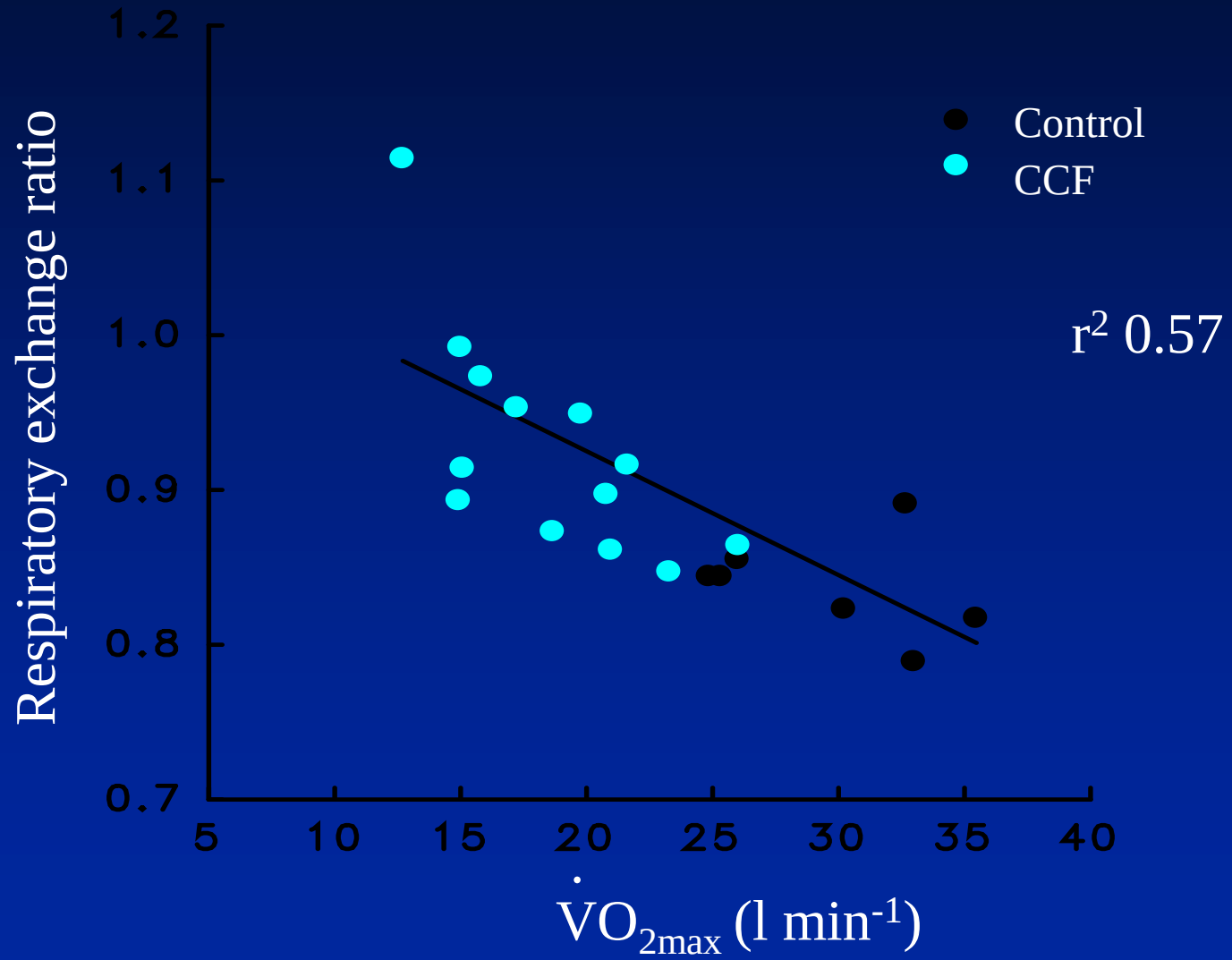
2.7 km h^{-1} 5% slope



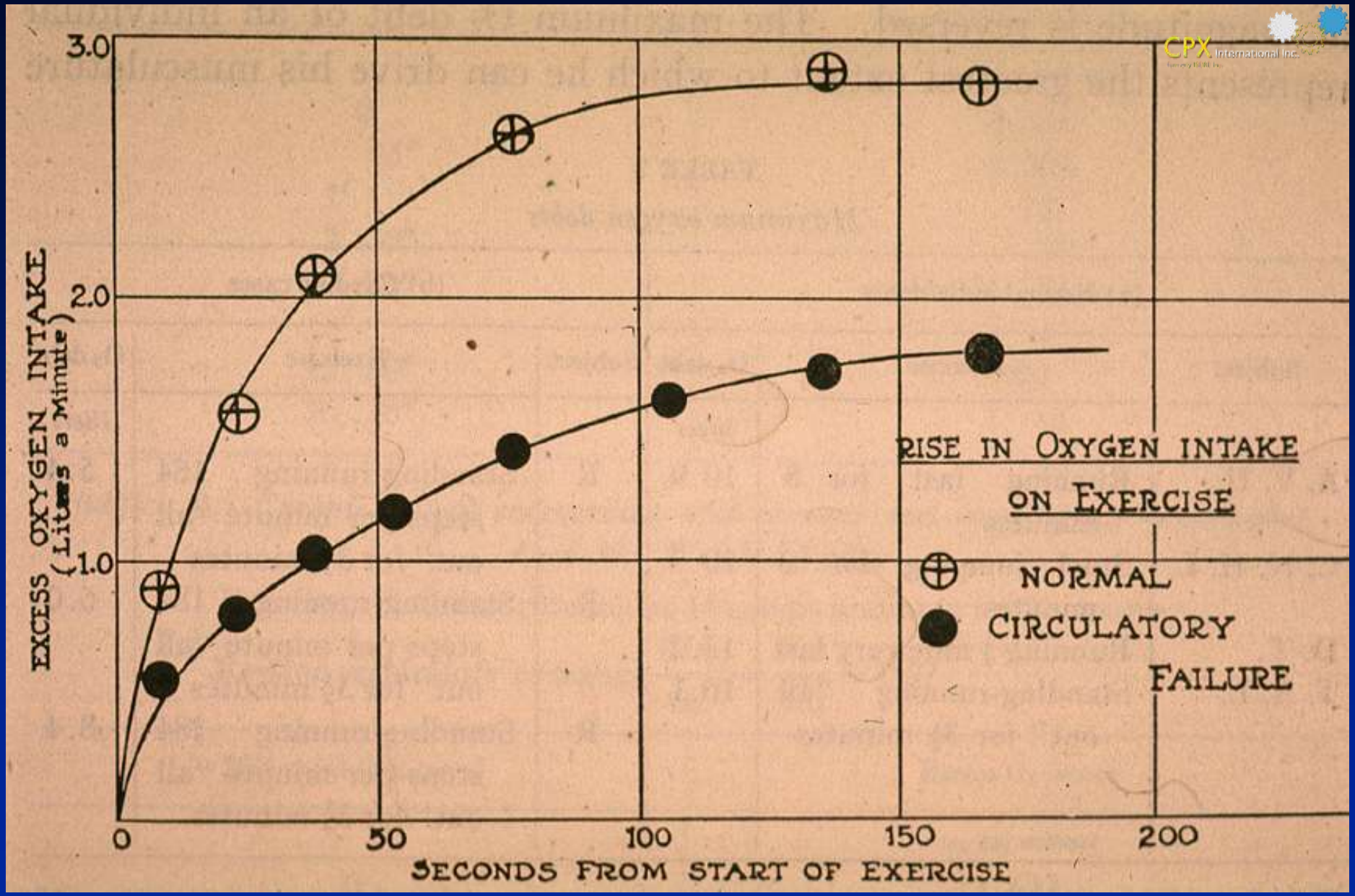
Riley et al.

End-exercise R

2.7 km h^{-1} 5% slope



Riley et al

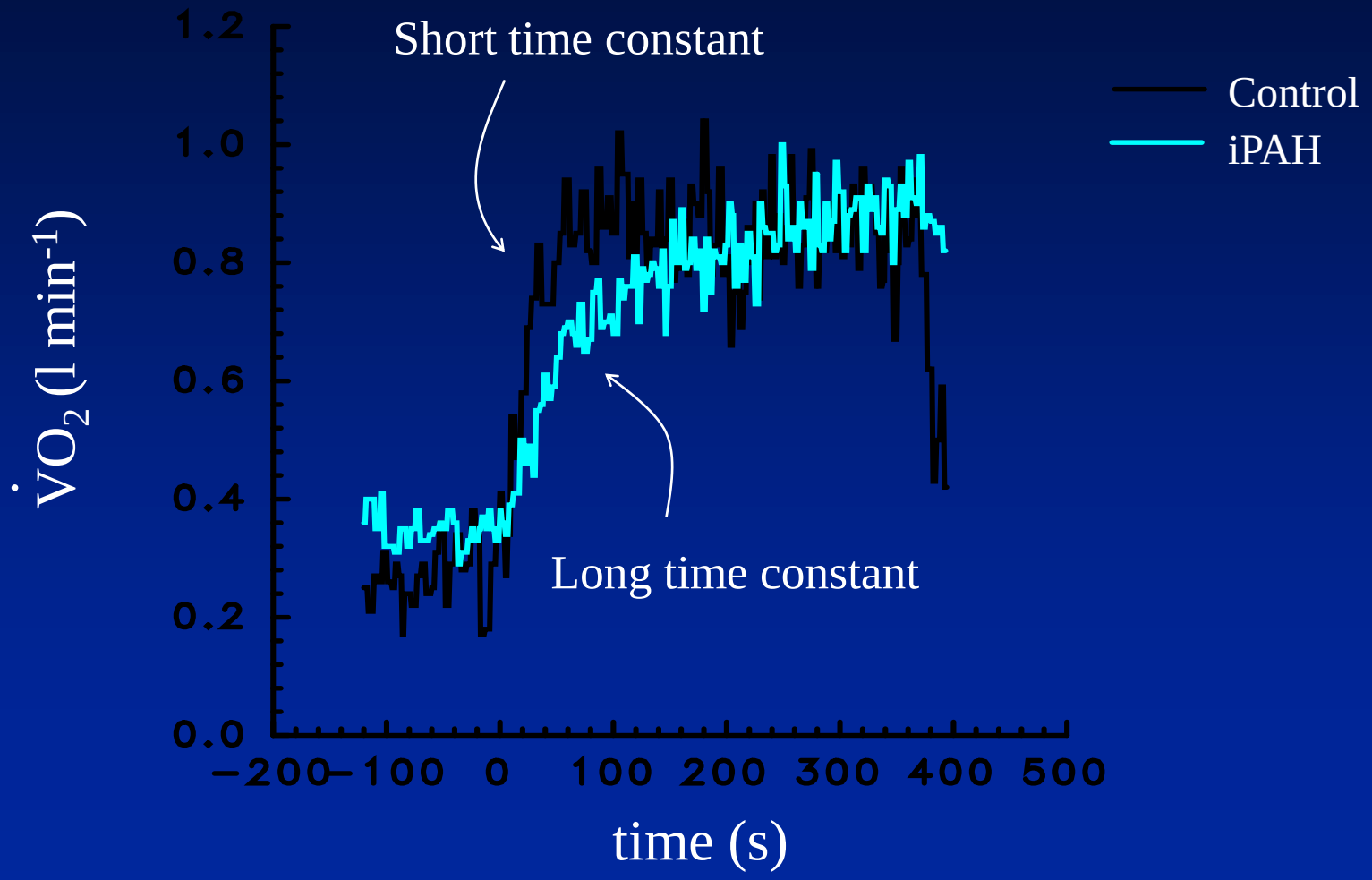


Meakins & Long J Clin Invest 1927; 4: 273-293.

L did exercise at the set rate…with practically no discomfort, and soon recovered afterwards.

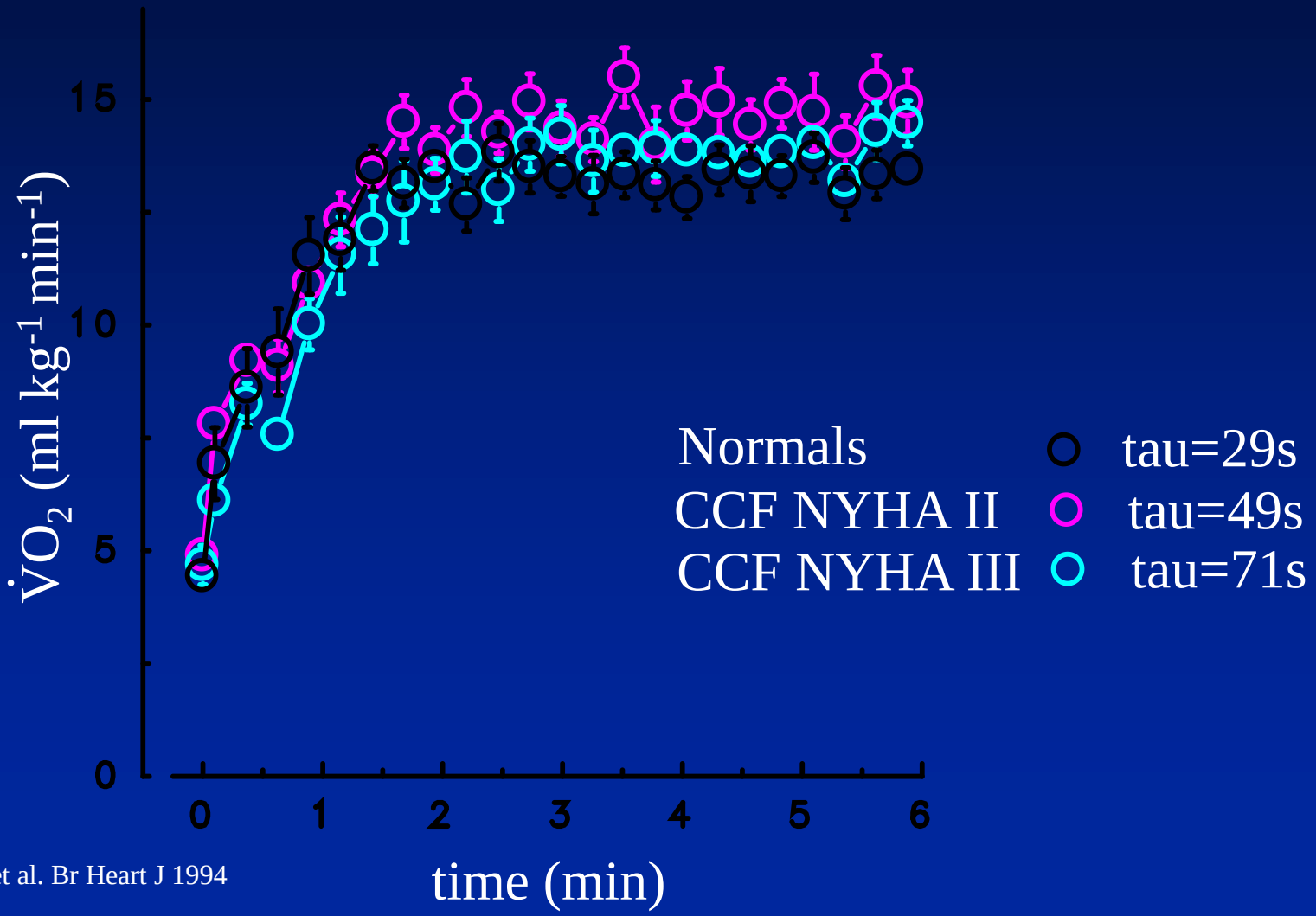
R, on the other hand, was always greatly distressed, and usually had to be driven to complete it.

40W Constant work rate



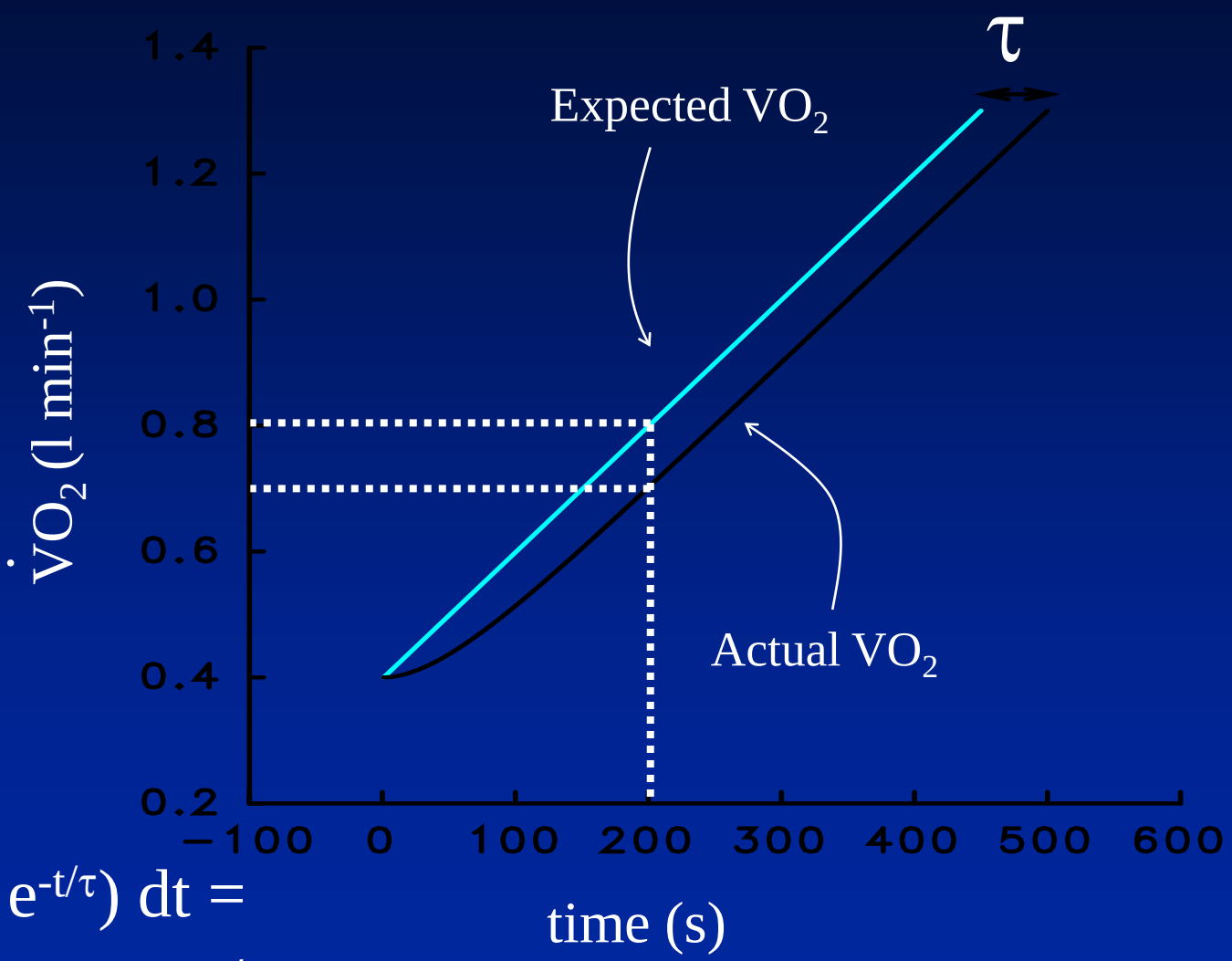
Riley et al. JACC 1992

Constant workrate exercise



Riley et al. Br Heart J 1994

Ramp model



Riley et al

$$\int A(1 - e^{-t/\tau})\, dt =$$

$$At + A\tau e^{-t/\tau} + c$$

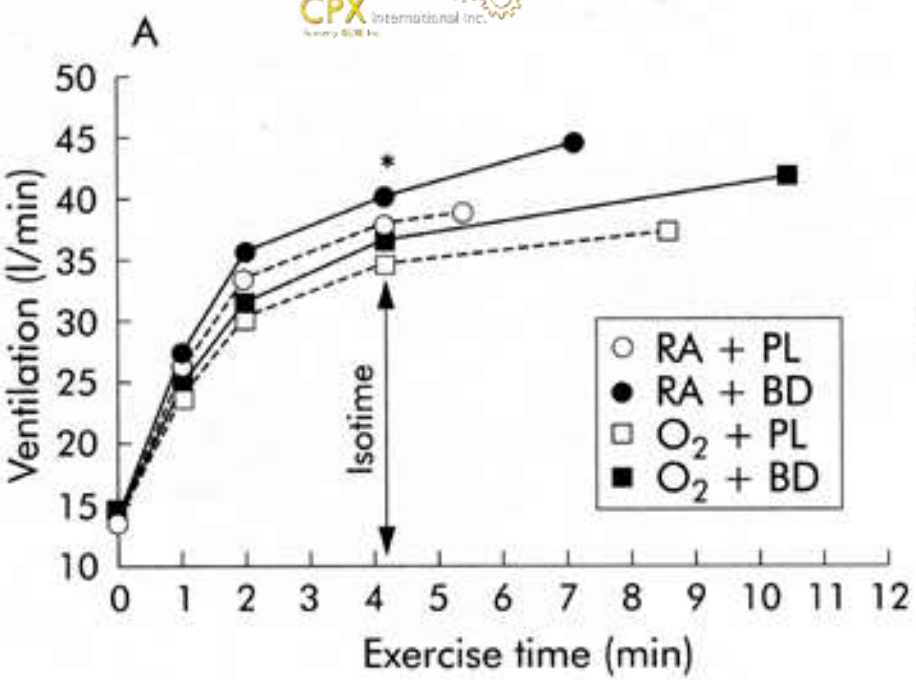
Applications

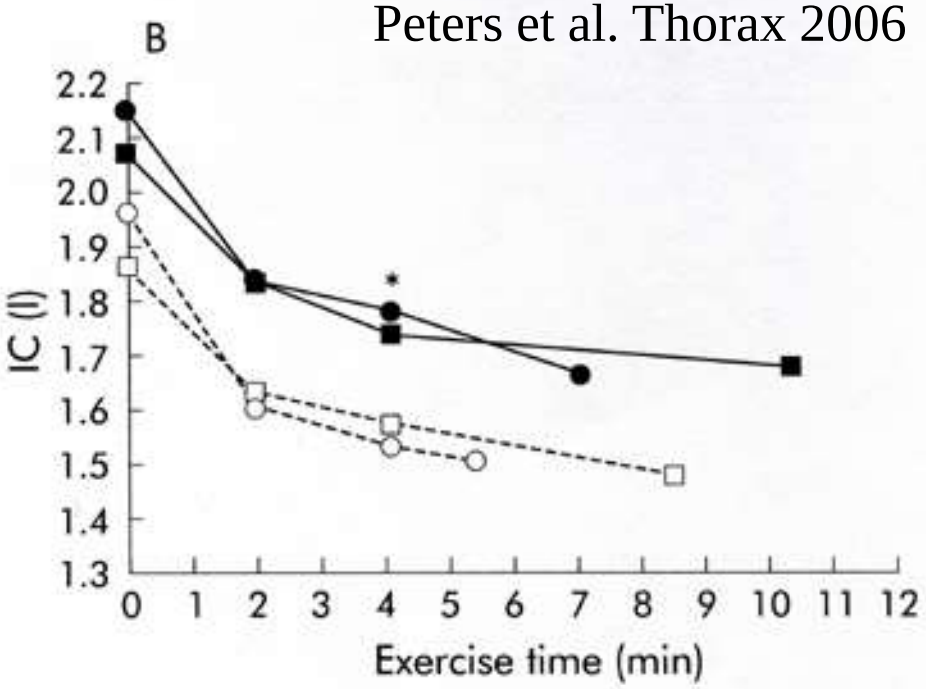
Constant work rate exercise

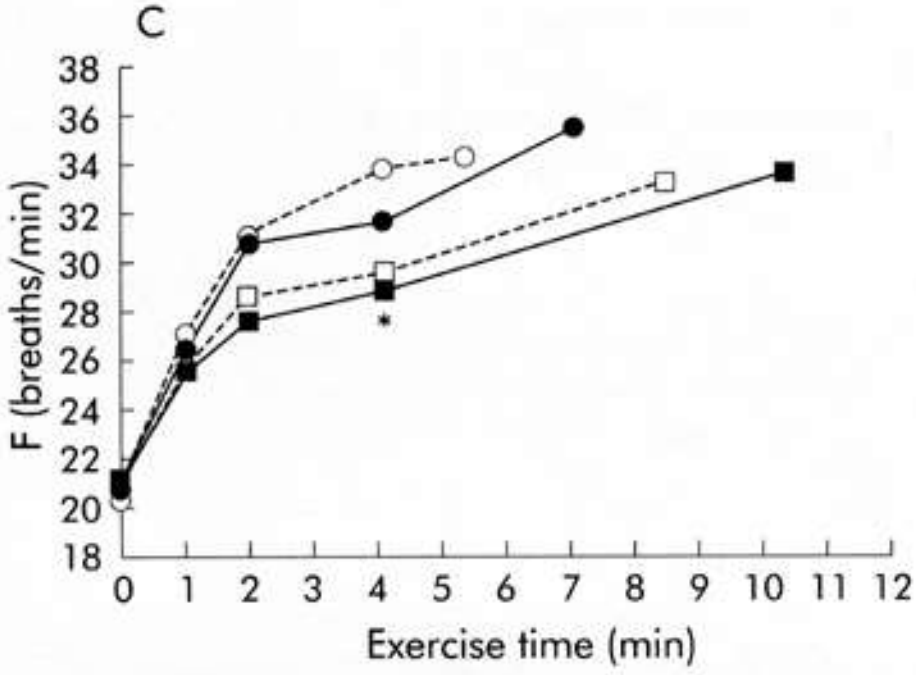
- Reflects daily activity better than ramp exercise
- May be less demanding than ramp exercise
- Yields additional physiological information to ramp exercise

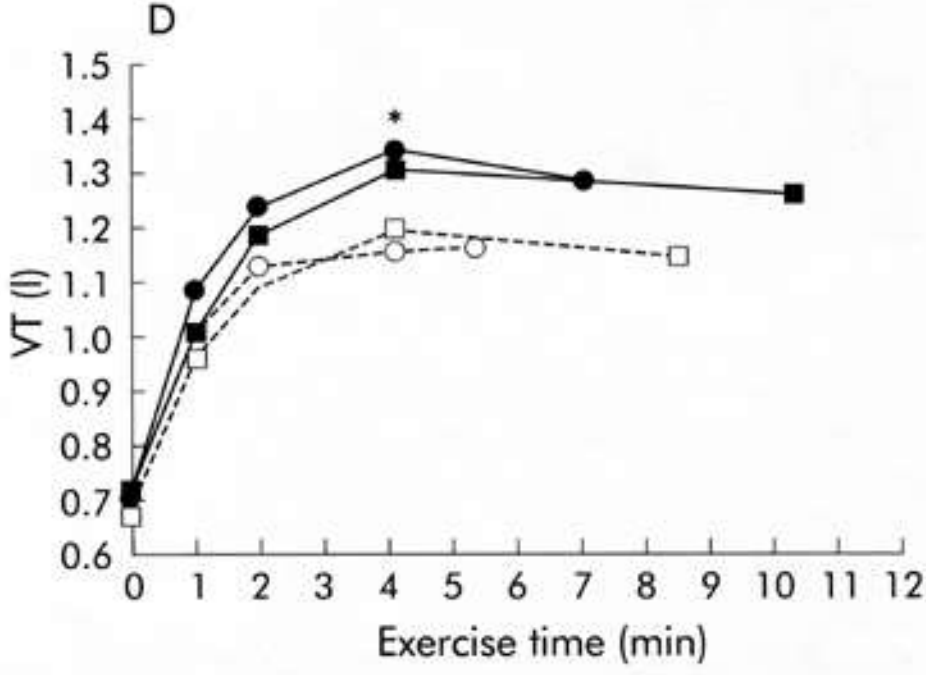
Riley et al

Peters et al. Thorax 2006

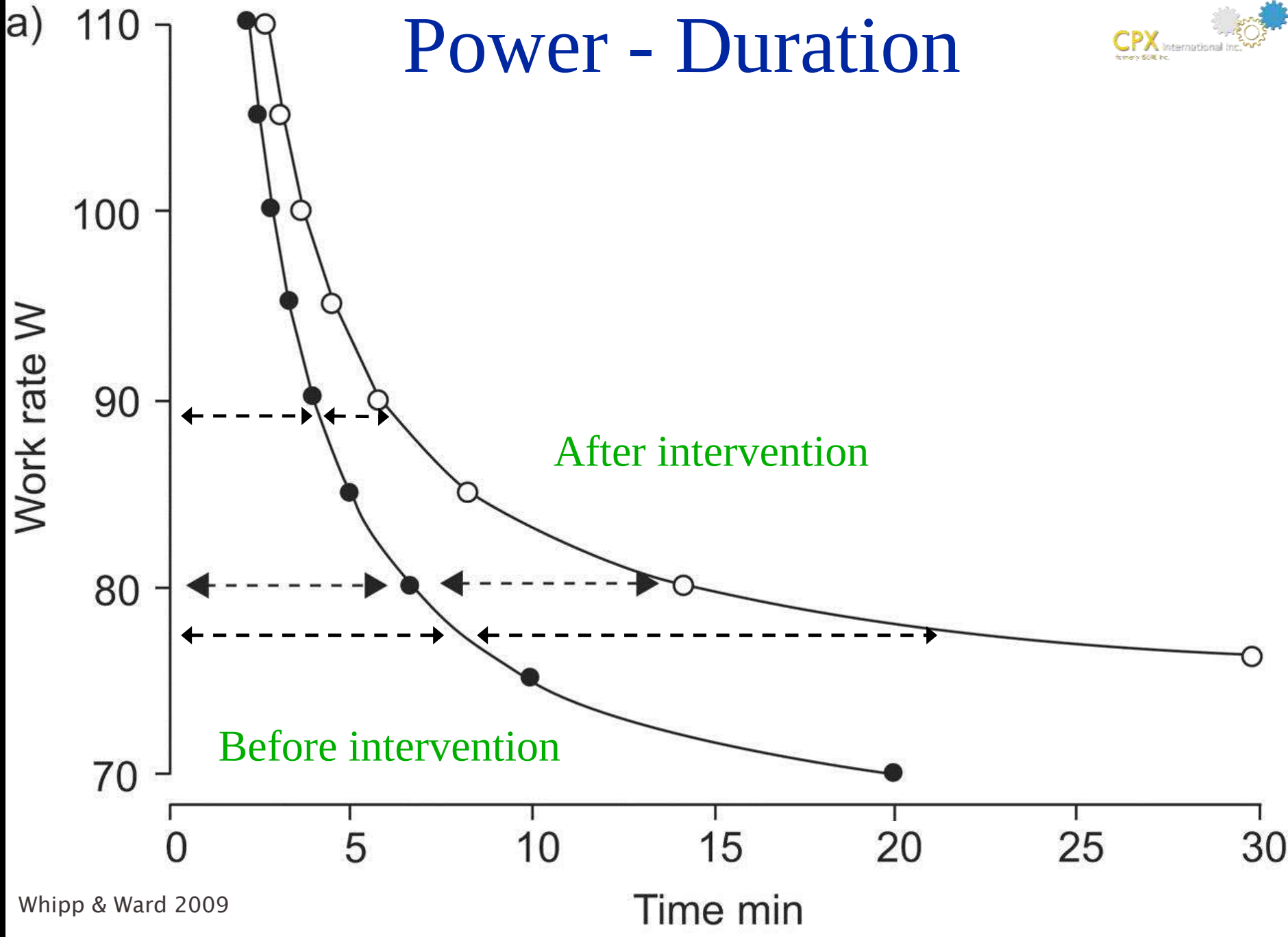




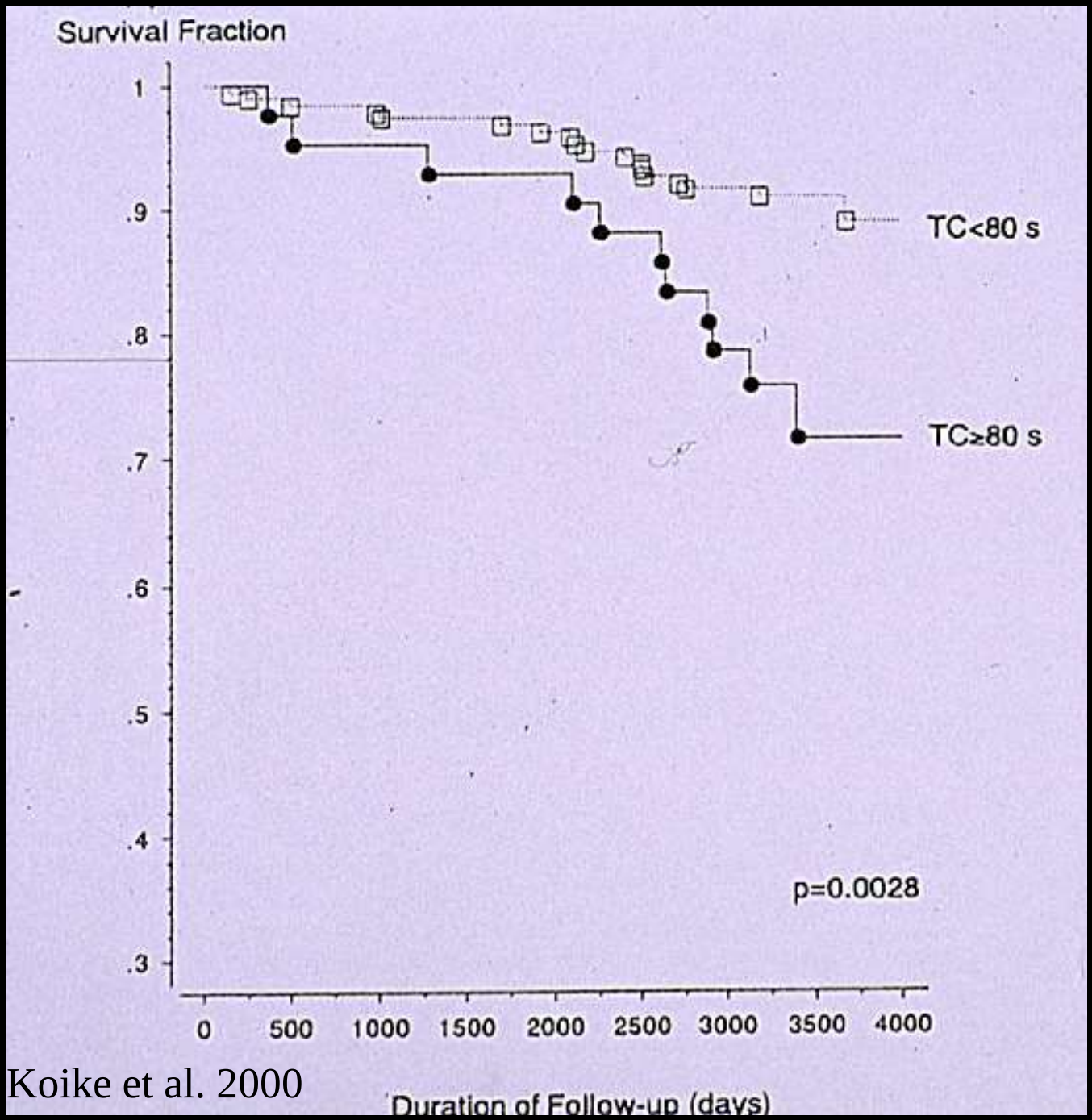




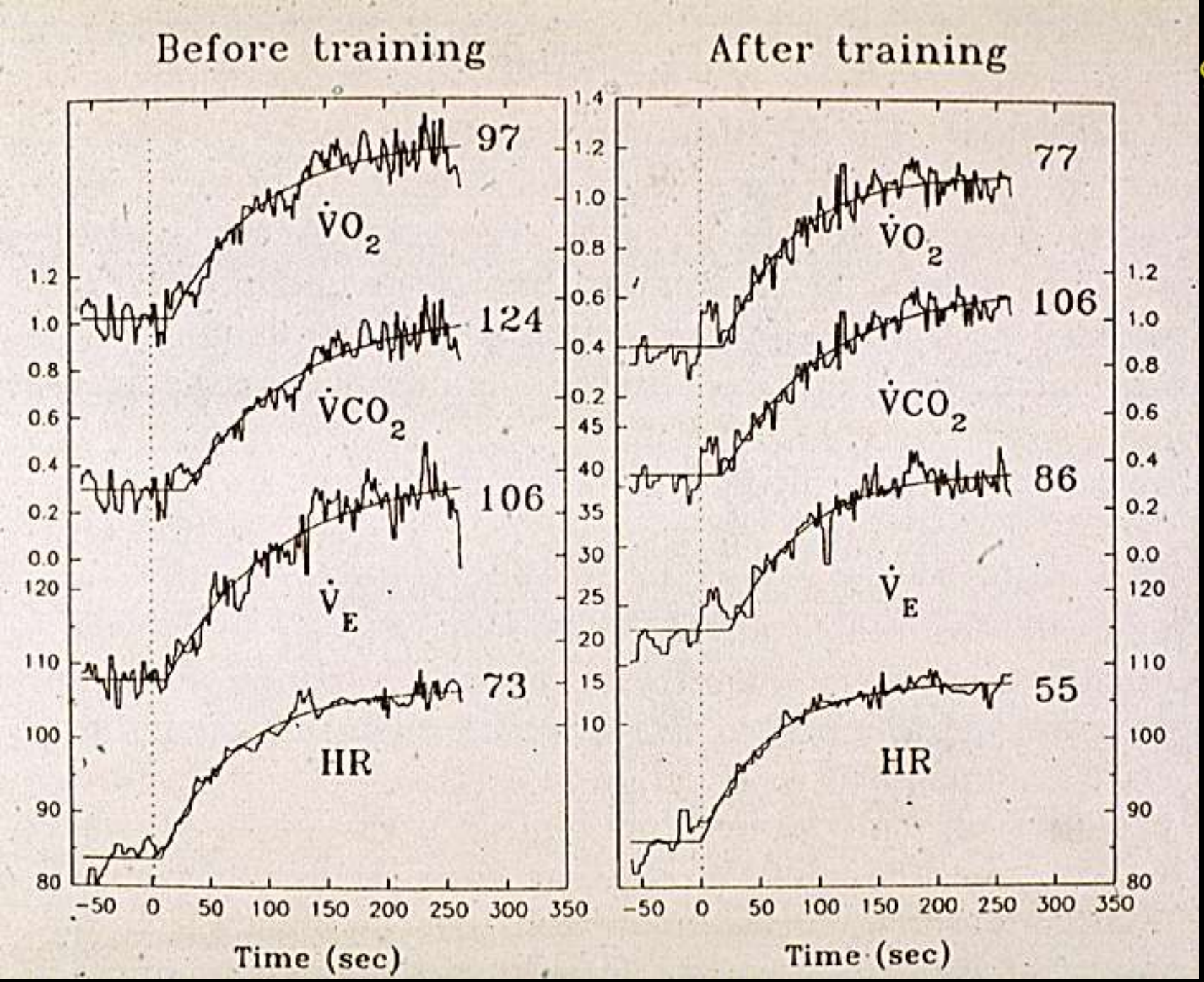
Power - Duration



Whipp & Ward 2009



Koike et al. 2000



Casaburi et al. 1997

Indirect Calorimetry

Fat

$$C_{16}H_{32}O_2 + 23O_2 \longrightarrow 16CO_2 + 16H_2O$$

RQ ~ 0.7

Carbohydrate

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$$

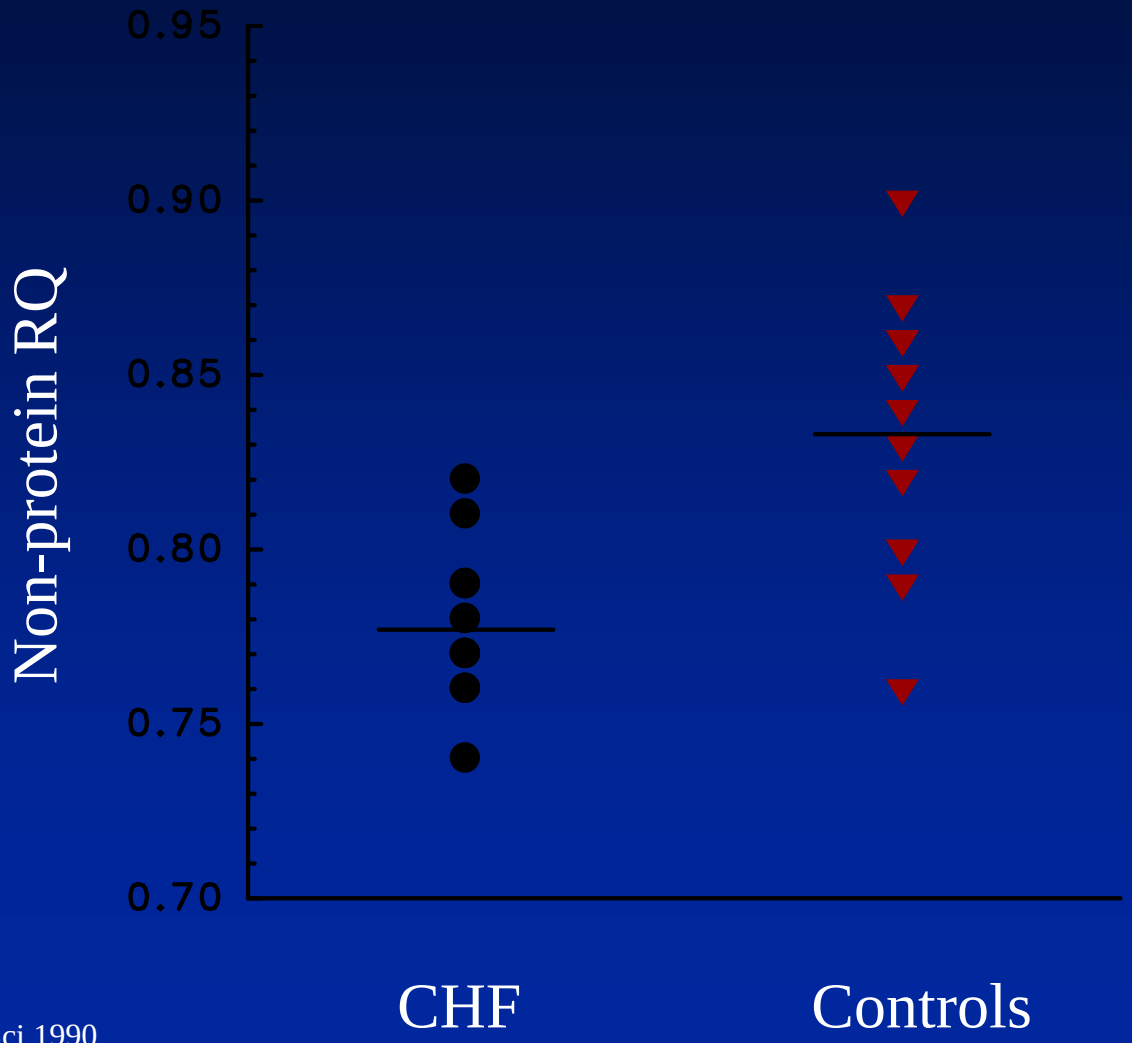
RQ = 1.0

Gas stores

	Blood & tissues (ml)	Alveolar gas (ml)
CO_2	6100	120
O_2	1080	300
N_2	996	1560

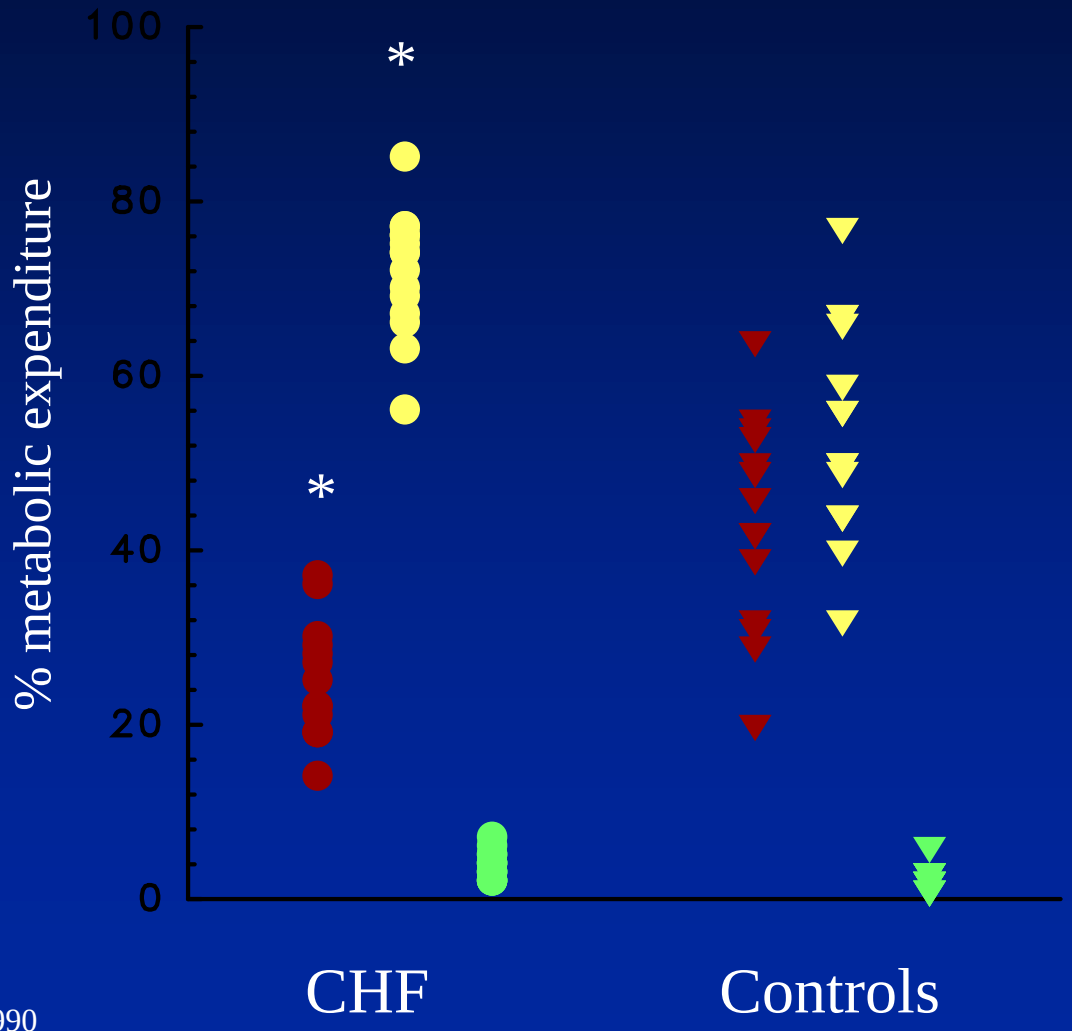
RER = RQ

RQ during exercise



Riley et al. Clin Sci 1990

Substrate utilization



* p<0.0005

- Carbohydrate
- Lipid
- Protein

Riley et al. Clin Sci 1990

Constant work rate exercise

- Normal patterns of gas exchange
- Mechanisms of slow component
- Disease patterns
- Applications