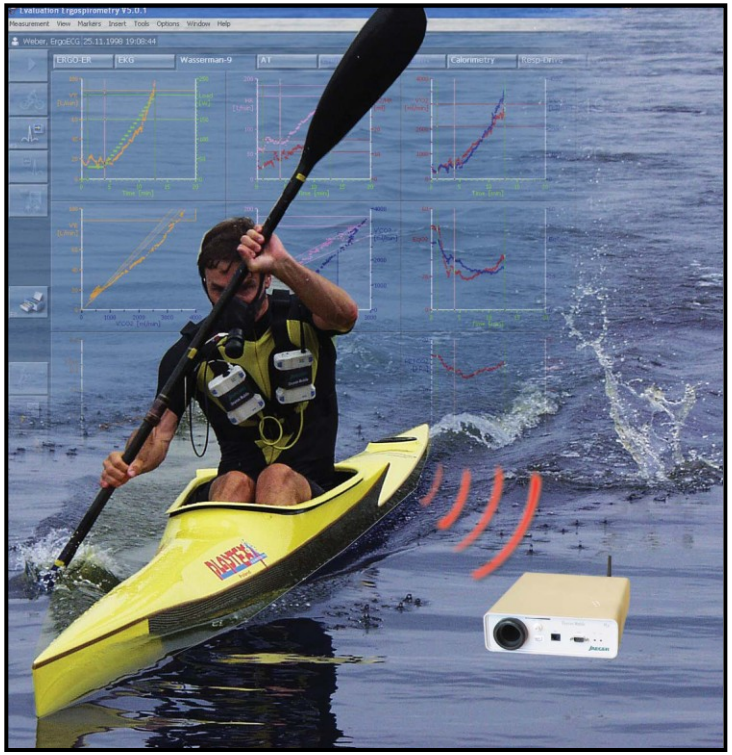
Performance Diagnostics

LABORATORY TESTS

EXTERIOR TESTS



DIAGNOSTICS of abilities

AEROBIC

ANAEROBIC

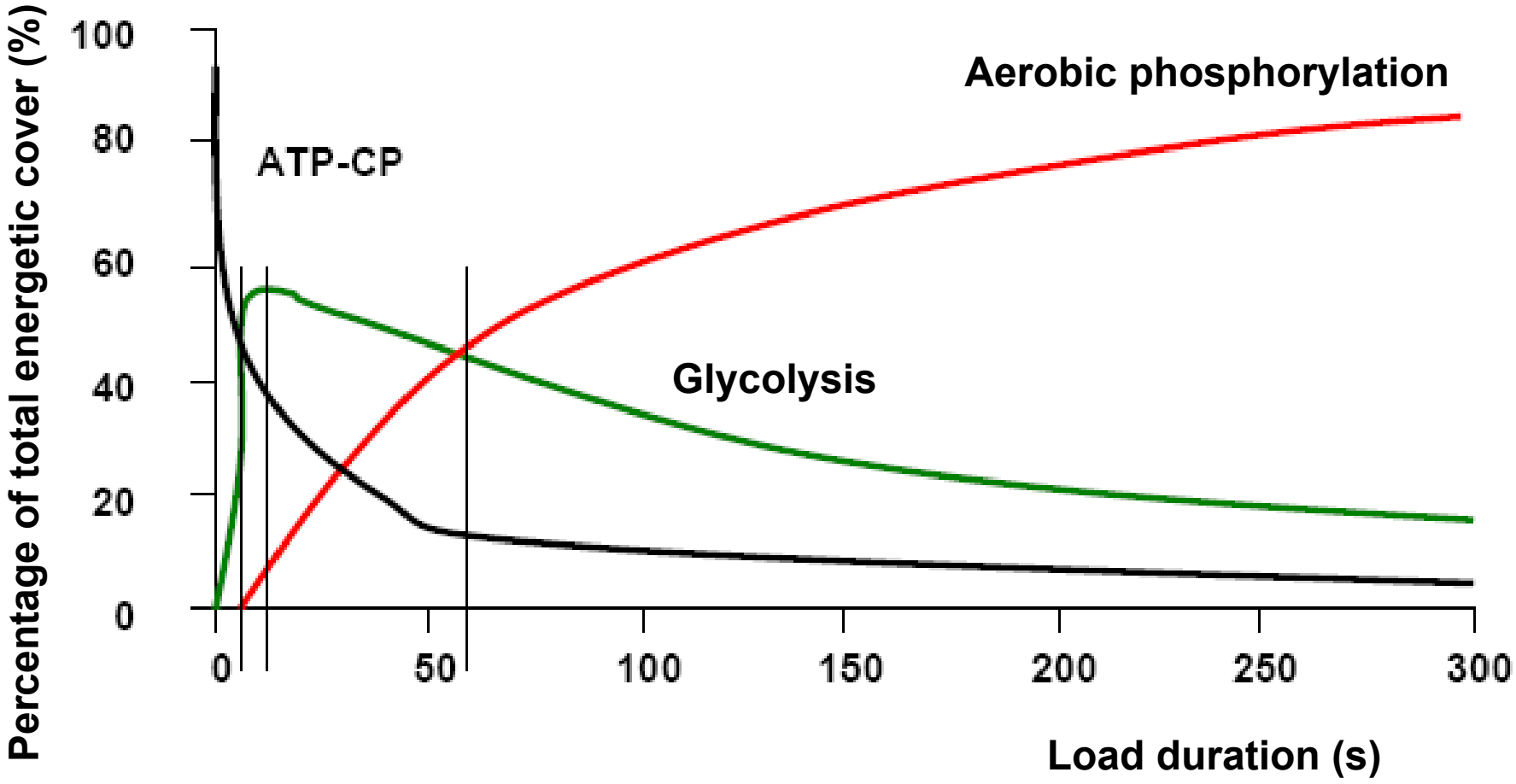
Anaerobic abilities diagnostics

Wingate test

Oxygen deficit/debt

Bosco ergo jump test

Particular energetic systems ratio in maximal load (Stejskal 2006; taken from Gastin 2001)



Anaerobic tests

- Aim to assesment of non-oxidative energetic sources used to produce ATP in working muscles.
- Short-term performance predispositions can be predicted based on anaerobic tests.

Anaerobic predispositions markers:

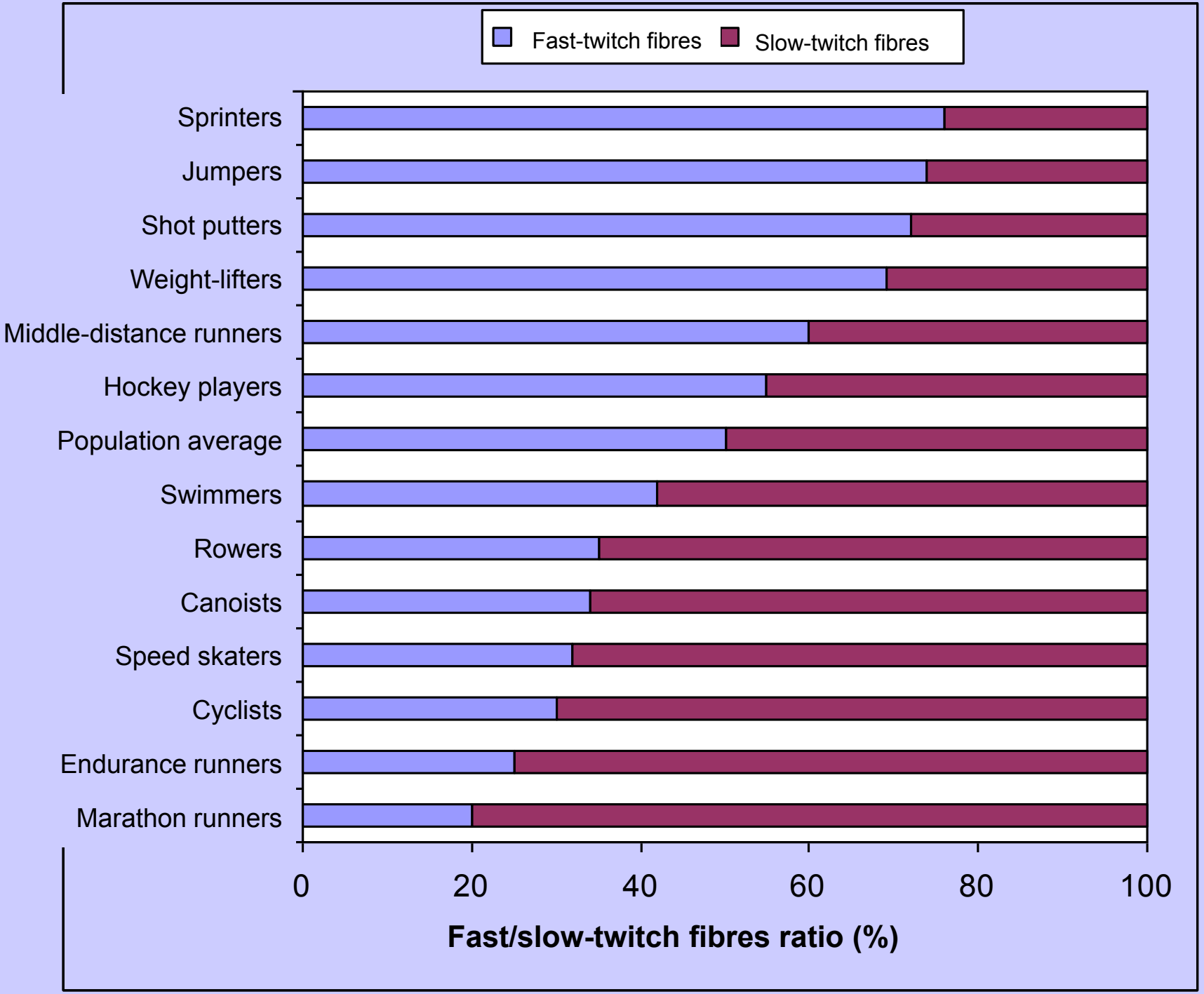
- metabolic,
- biochemical,
- histochemical.

(Incl. breathed gases analysis, blood-sample-based lactate evaluation, pH, muscle biopsy, et cetera.)

Further methods test physical performance using stairs, treadmill, bicycle ergometer, et cetera.

Main characteristics of muscle fibre types

	Slow-twitch (ST)	Fast-twitch (FTa)	Fast-twitch (FTb)
Contraction speed	low	high	high
Contraction power	low	medium	high
Fatigue resistance	high	medium	low
Glycogen volume	low	high	high
Diameter	low	medium	high
Mitochondrial density	high	high	low
Capillary density	high	high	low
ATPase activity	low	high	high
Glycolytic capacity	low	high	high


Fast-twitch fibres
Slow-twitch fibres
Sprinters
Jumpers
Shot putters
Weight-lifters
Middle-distance runners
Hockey players
Population average
Swimmers
Rowers
Canoists
Speed skaters
Cyclists
Endurance runners
Marathon runners
0
20
40
60
80
100
Fast/slow-twitch fibres ratio (%)

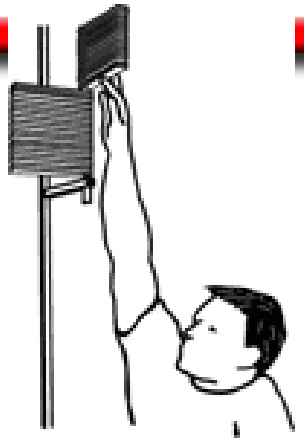
Muscle fibres diagnosis

Invasive method – muscle biopsy

- Magnetic resonance + biochemical analysis of the recorded muscle

- Bosco ergo jump test

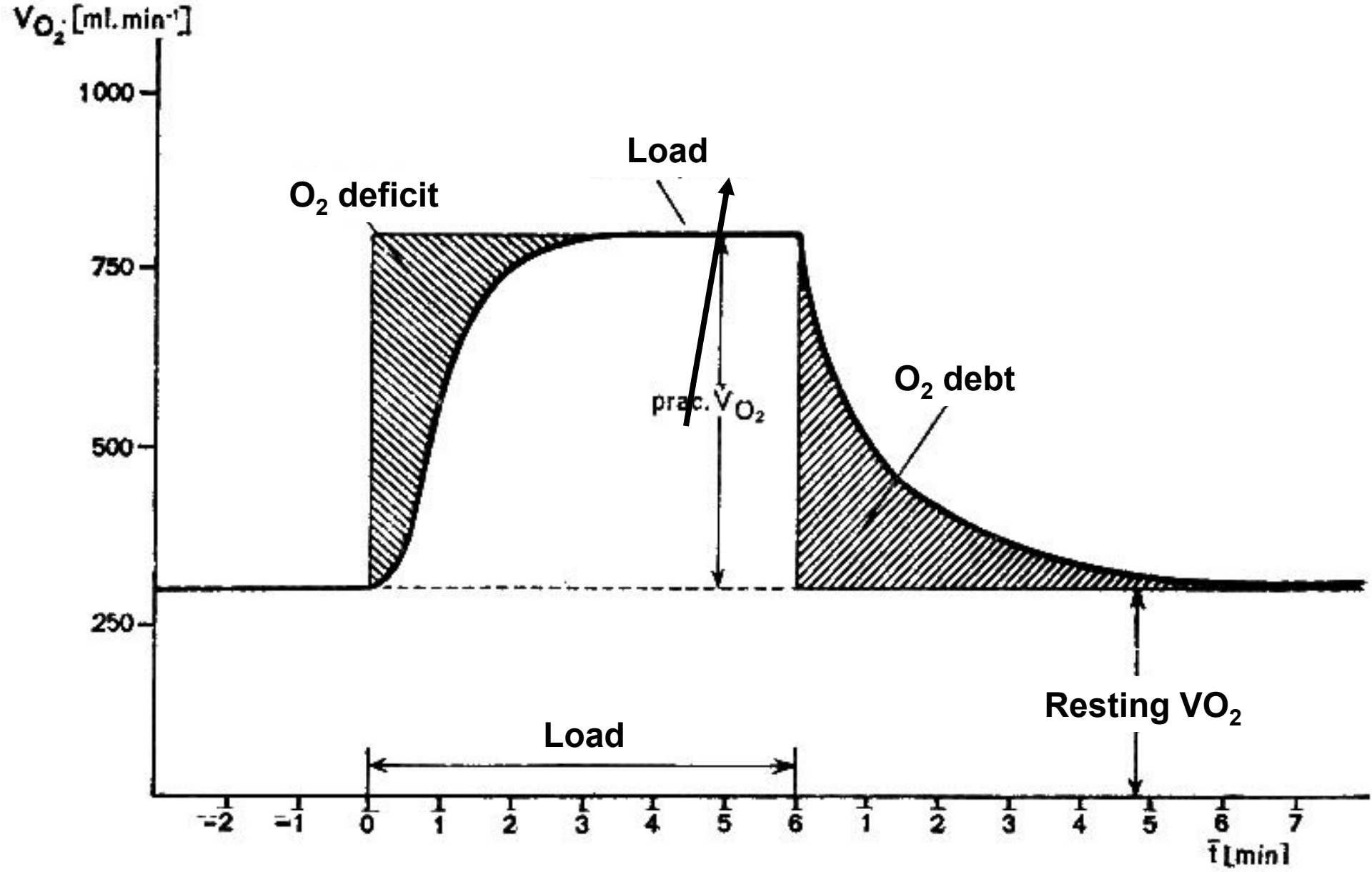
- Vertical jump
- Margaria test (step-running test)
- Anaerobic capacity test – treadmill sprint
- Isokinetic test
- Oxygen deficit during spiroergometry
- Wingate test
- Bosco ergo jump test



Oxygen deficit/debt

- **Maximum level of oxygen deficit** – oxygen volume theoreticaly remaining to VO_2max (during maximal continuous exercise until exhaustion) [l].

- **Maximum oxygen debt (recovery VO_2)** – oxygen volume surpassing resting oxygen intake (after load until rest) [l].


V_{O_2} [ml.min^{-1}]
1000
750
500
250
Load
O_2 deficit
prac. $\dot{V}_{O_2}$
O_2 debt
Resting VO_2
Load
-2
-1
0
1
2
3
4
5
6
1
2
3
4
5
6
7
t [min]

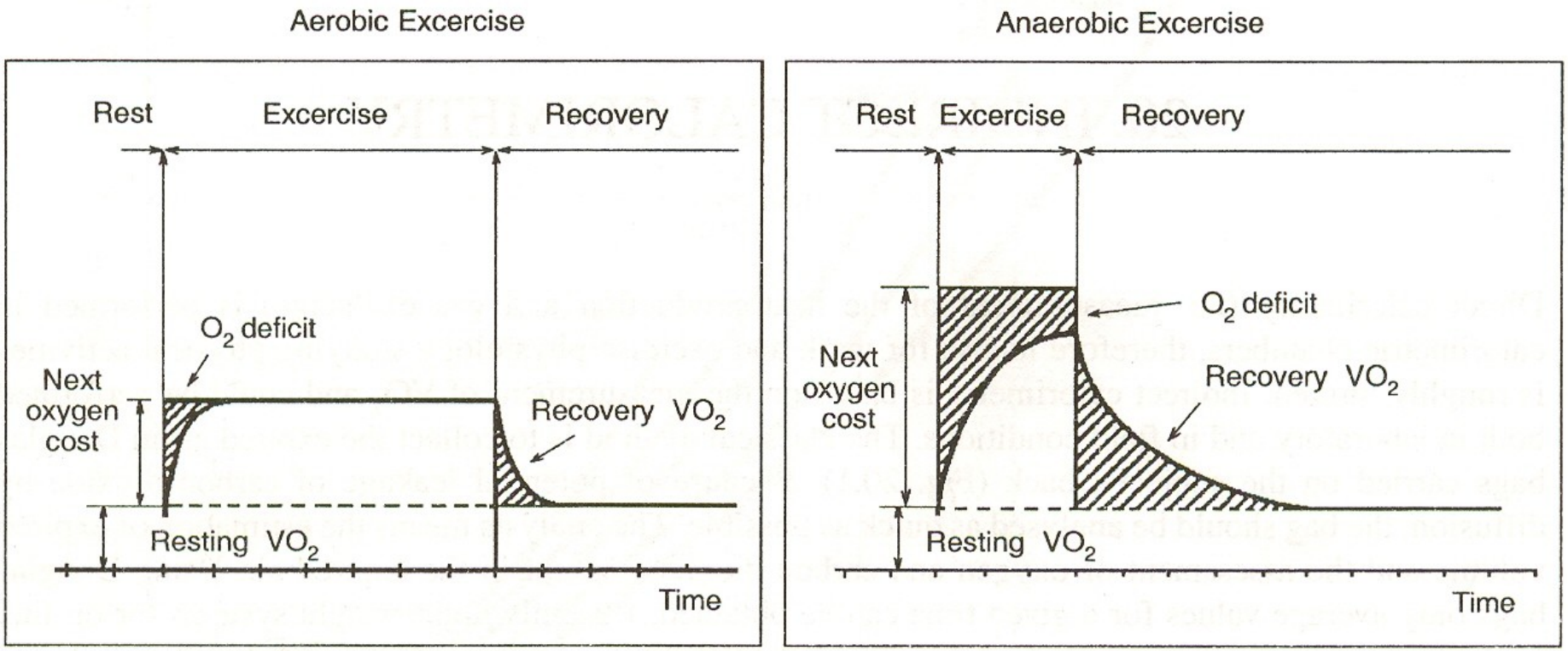


Fig. 20.2 Principle of indirect calorimetry, i.e. measurement of VO_2 at rest, during exercise and recovery.

E.P.O.C.

- What is it?
  - Excess Postexercise Oxygen Consumption
- What does it mean E.P.O.C.?
  - Oxygen consumed to bring physiological variables to resting level

- **Hormone balancing,**
- **replenishment of fuel stores,**
- **cellular repair,**
- **innervation,**
- **anabolism,**
- **new ATP synthesis,**
- **phosphate groups form creatine.**

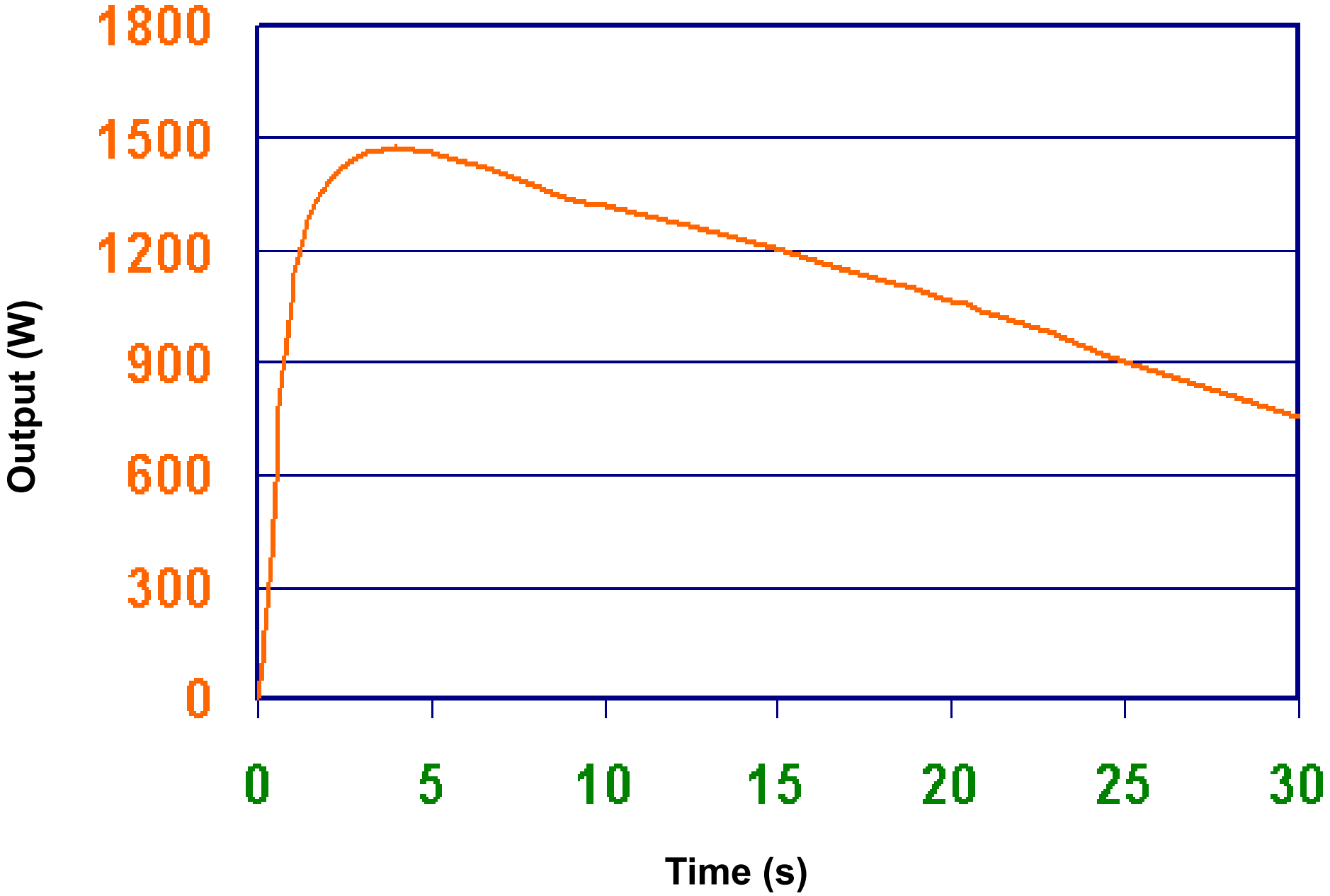
Wingate test

(Wingate anaerobic test WAnT)

- 30 s pedaling at maximal speed (on isokinetic bicycle ergometer
- Constant resistence (individually 0.75 N m/kg)

Wingate test – parameters

- Peak power – W, W/kg
- Mean power – W, W/kg
- Total work / Anaerobic capacity – J, J/kg
- Fatigue index / Rate of fatigue – %


1800
1500
1200
900
600
300
0
Output (W)
0
5
10
15
20
25
30
Time (s)

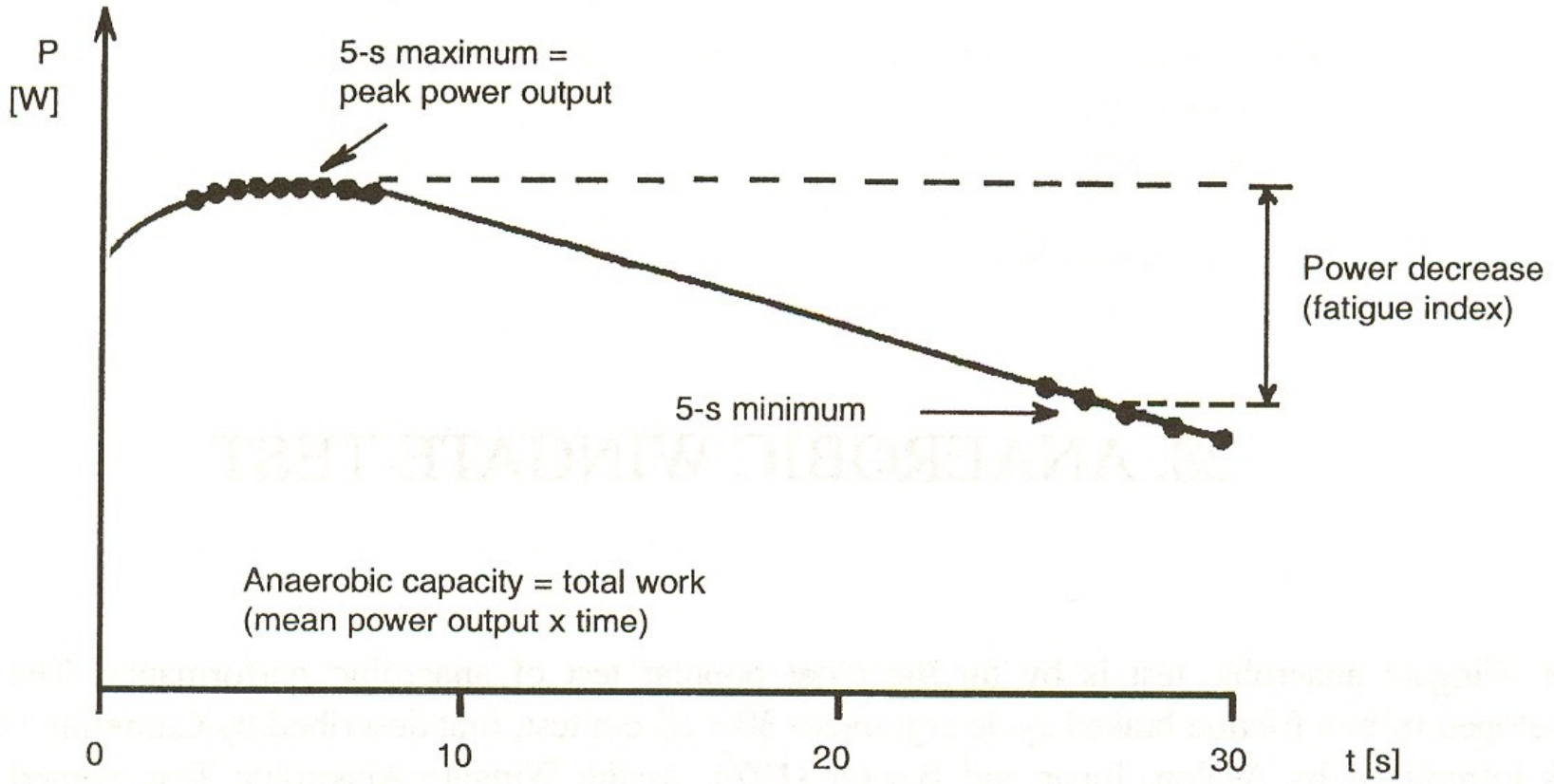


Fig. 28.1 Power output in the Wingate test and indices of the test.

Wingate test – average population (Lipková, 2006)

	Maximal output		Average output	
	W	W/kg	W	W/kg
Males	700	9.2	563	7.3
Females	454	7.6	381	6.4

Wingate test – sportswomen

	Maximal output		Anaerob. capacity	Fatigue index	Source
	W	W/kg	J/kg	%	Author, year
Sprint	-	11.4	272	37	Heller, 1999
Ice hockey	785	-	-	-	Hoffman, 2006
Swimming	-	10.8	265	34	Heller, 1999
Speed skating	-	12.3	-	-	Smith-Roberts, 1991
Tennis	699	-	-	-	Kraemer, 2003
Sport students	-	10.8	258	40	Heller, 1999

Wingate test – sportsmen

	Maximal output		Anaer. capacity	Fatigue index	Source
	W	W/kg	J/kg	%	Author, year
Speed skating	-	16.6	-	-	Smith-Roberts, 1991
Sprint	924*	14* 14.2	332	42	Granier, 1995* Heller, 1999
Ice hockey	785	11.7* 15.2	355	42	Heller, 1999 Lipková, 2006*
Gymnastics	-	12.3	-	-	Lipková, 2006
Wrestling	-	12.0	-	-	Lipková, 2006
Middle-distance run	-	10.0* 13.0	-	-	Lipková, 2006* Granier 1995
Basketball	-	14.4	-	-	Hoffman, 1999
Endurance run	-	9.3	-	-	Lipková, 2006
Sport students	-	12.3	292	46	Heller, 1999

Bosco ergo jump

- A mat is electrically connected during feet touch
- Measuring of lengths of flight and contact
- Evaluation of jump abilities

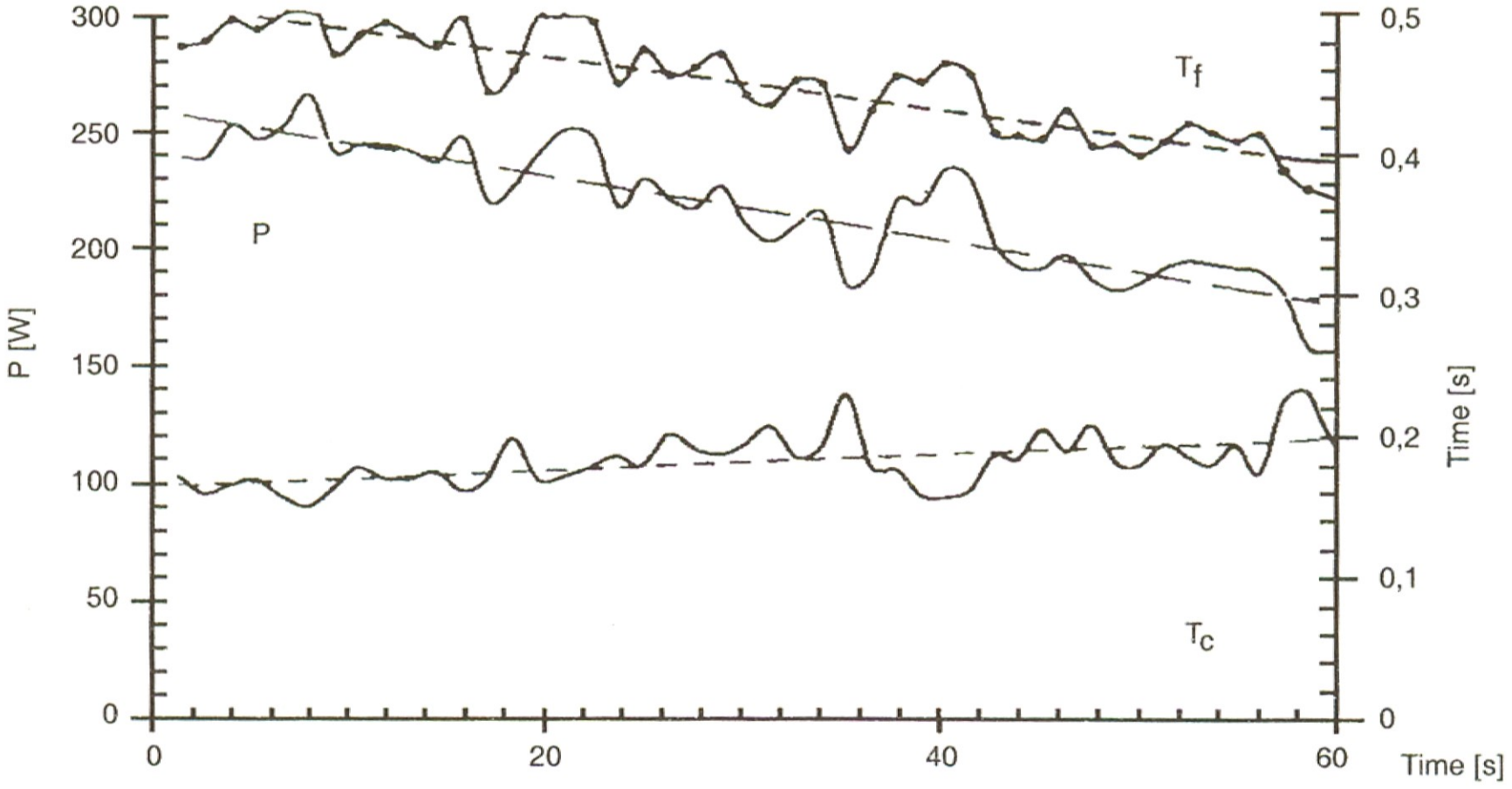
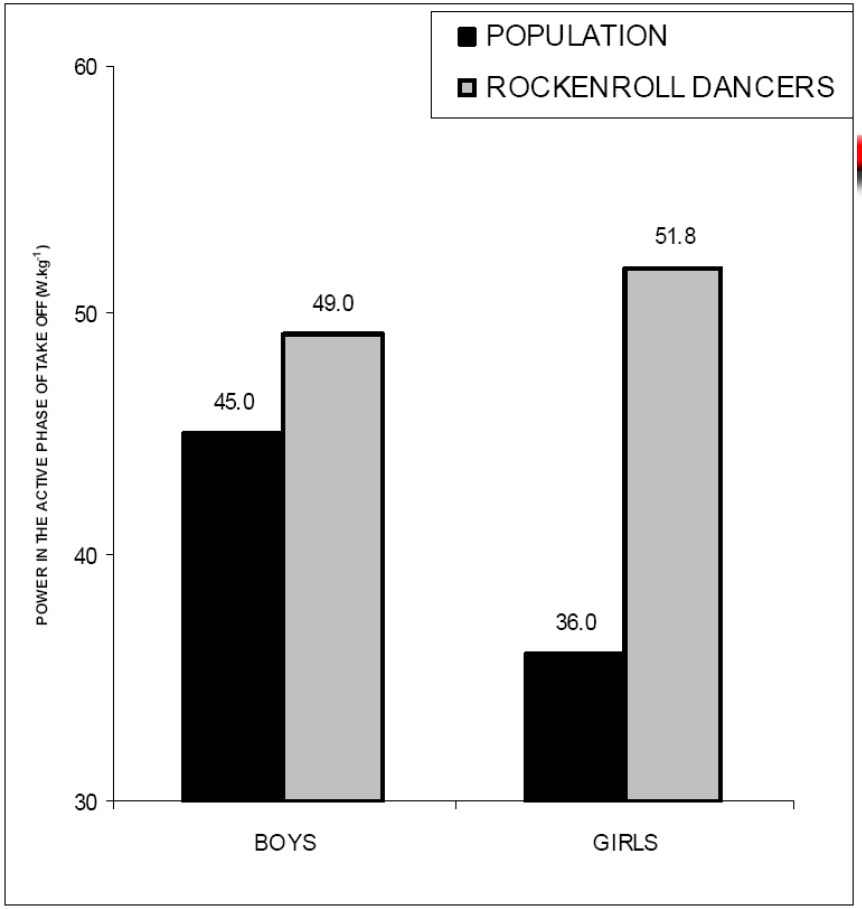
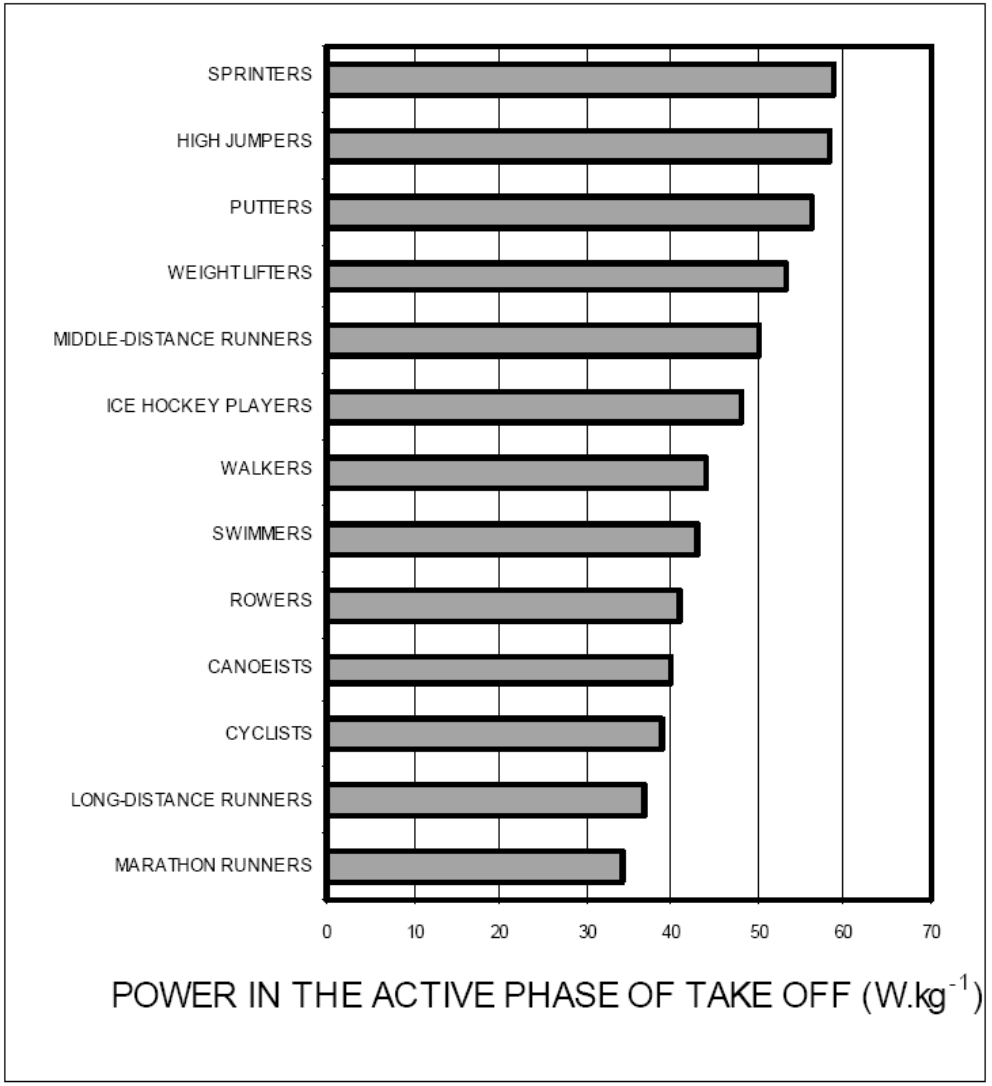
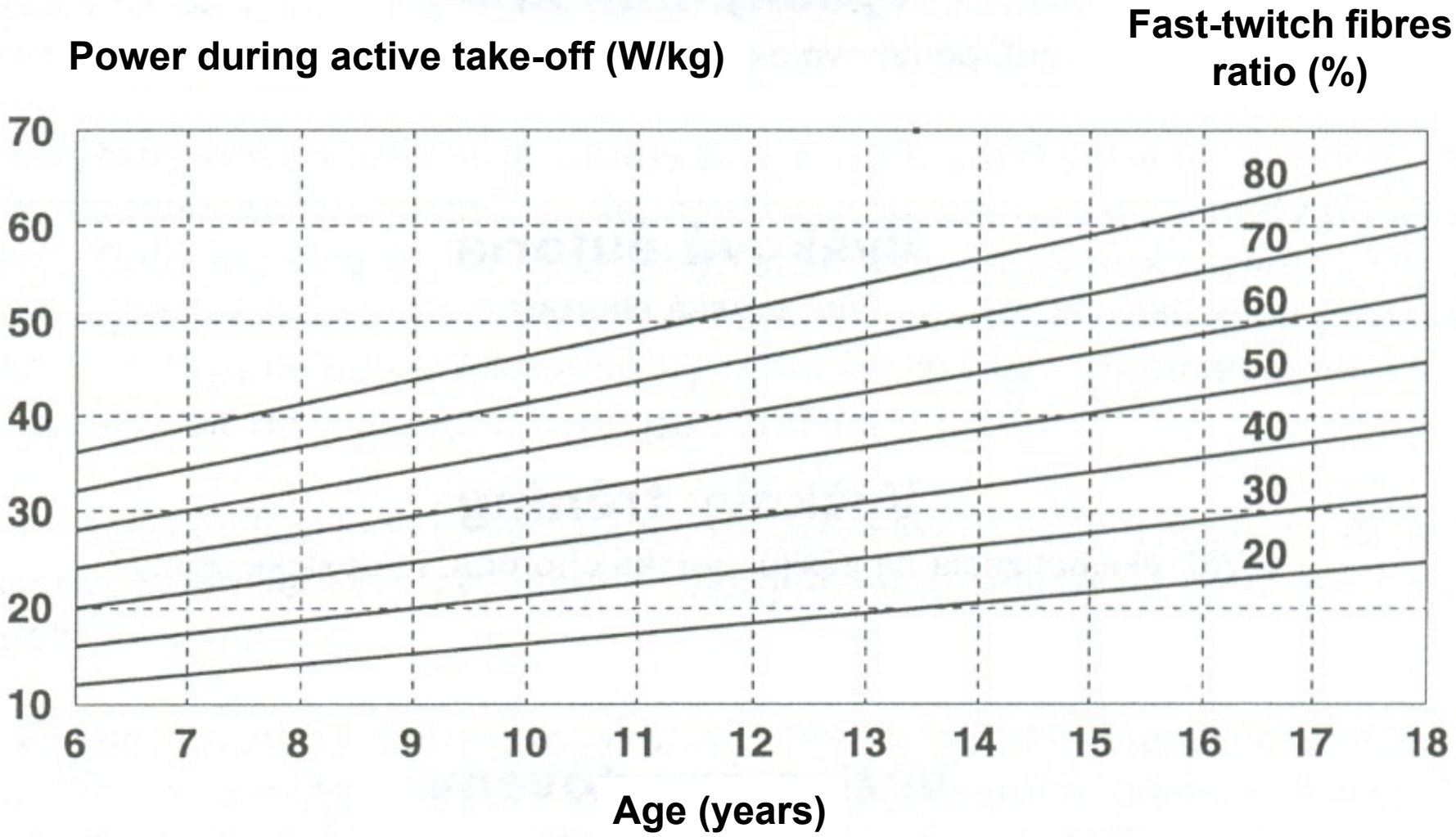


Fig. 30.2 Example of a 60-s Bosco test. Flight time (T_f) and power output (P) decrease and contact time (T_c) inversely increases throughout the 60-s test.

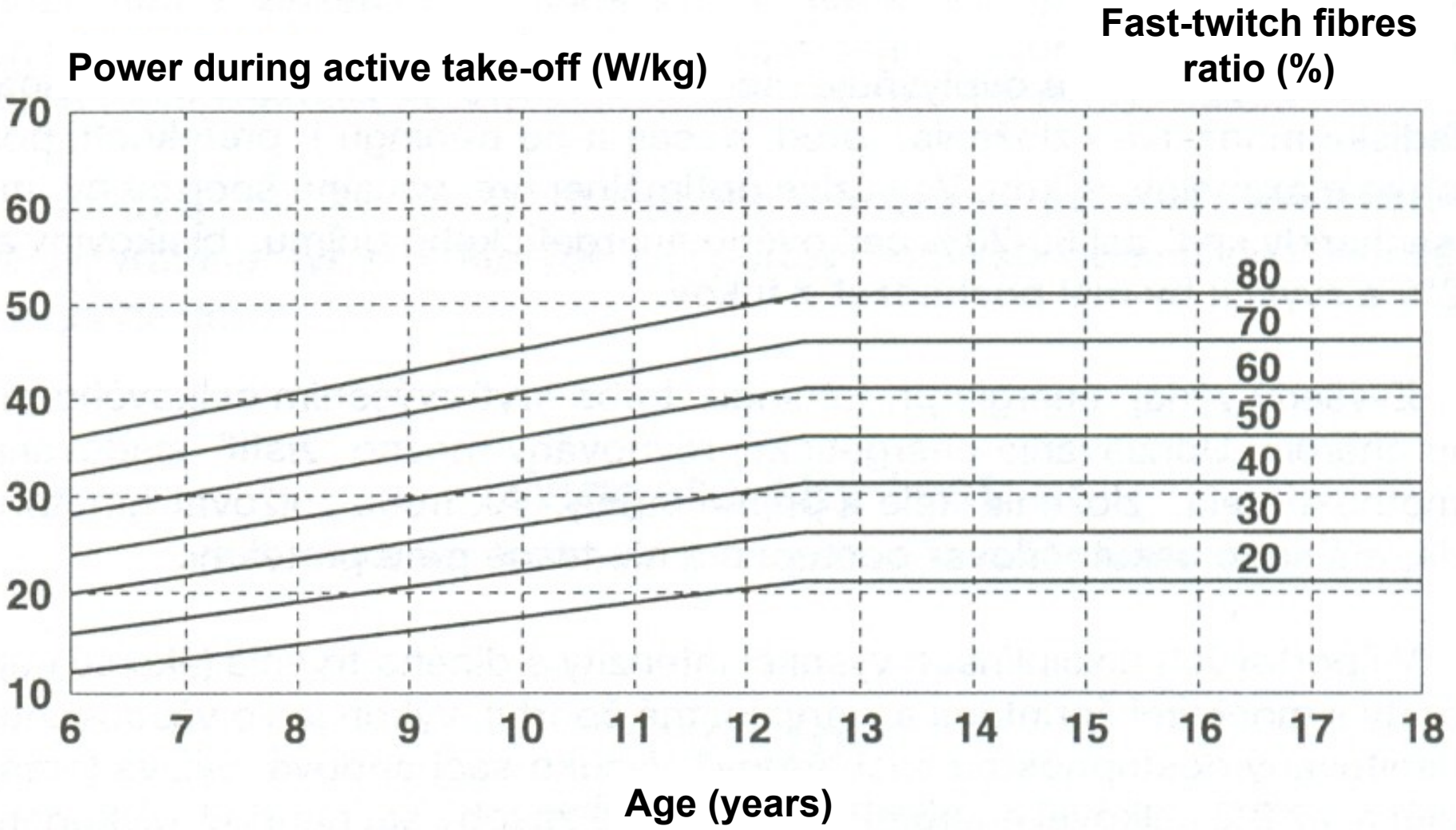

POPULATION
ROCKENROLL DANCERS
POWER IN THE ACTIVE PHASE OF TAKE OFF (W.kg-1)
60
50
40
30
45.0
49.0
36.0
51.8
BOYS
GIRLS


SPRINTERS
HIGH JUMPERS
PUTTERS
WEIGHT LIFTERS
MIDDLE-DISTANCE RUNNERS
ICE HOCKEY PLAYERS
WALKERS
SWIMMERS
ROWERS
CANOEISTS
CYCLISTS
LONG-DISTANCE RUNNERS
MARATHON RUNNERS
0
10
20
30
40
50
60
70
POWER IN THE ACTIVE PHASE OF TAKE OFF (W.kg-1)

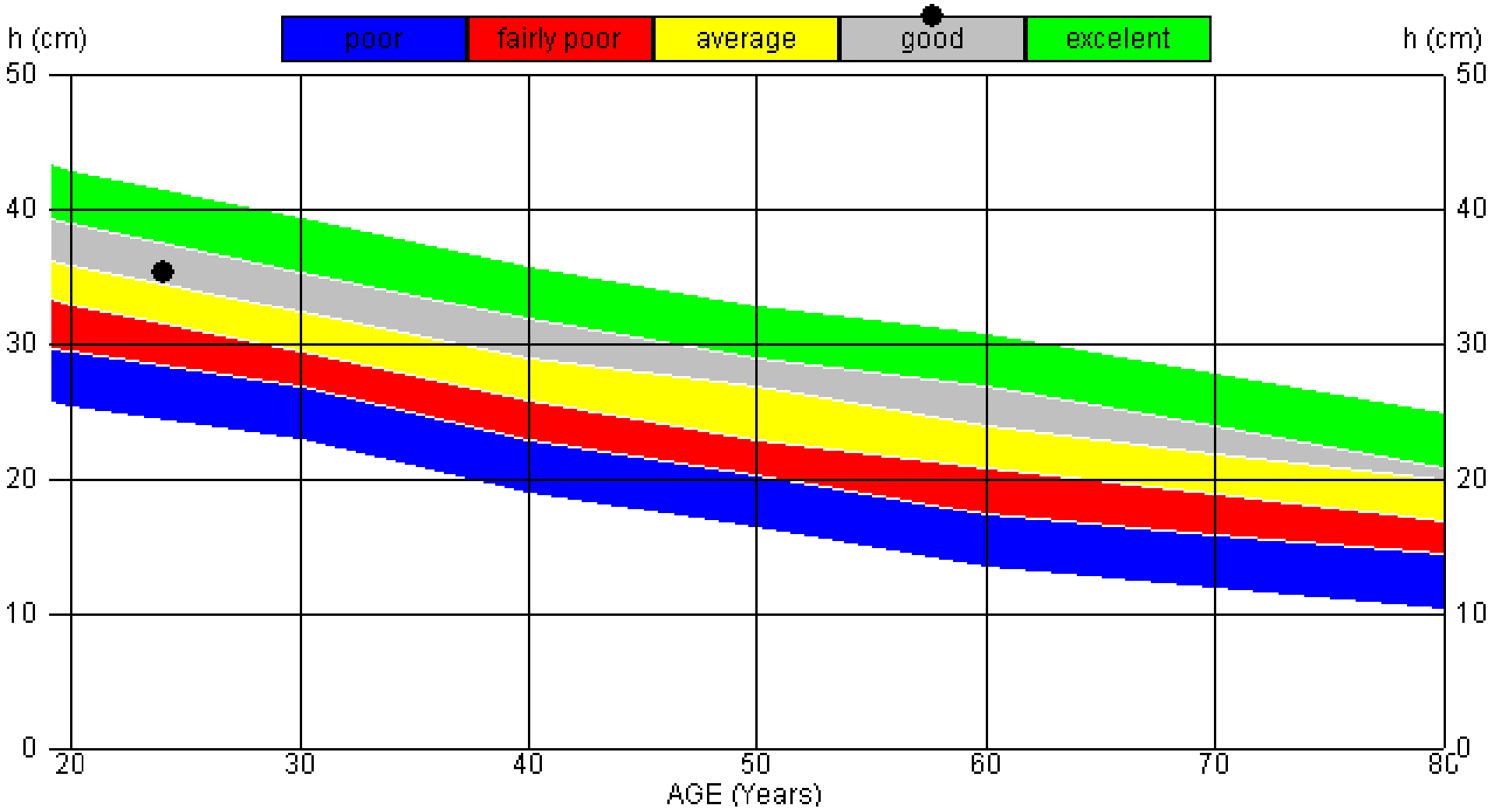
Fast-twitch fibres ratio in boys (Flemr, 2014)



Fast-twitch fibres ratio in girls (Flemr, 2014)



Jump height / age dependency in men (Flemr, 2014)



Jump height / age dependency in women (Flemr, 2014)