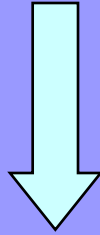


STRESS TESTS



LABORATORY TESTS

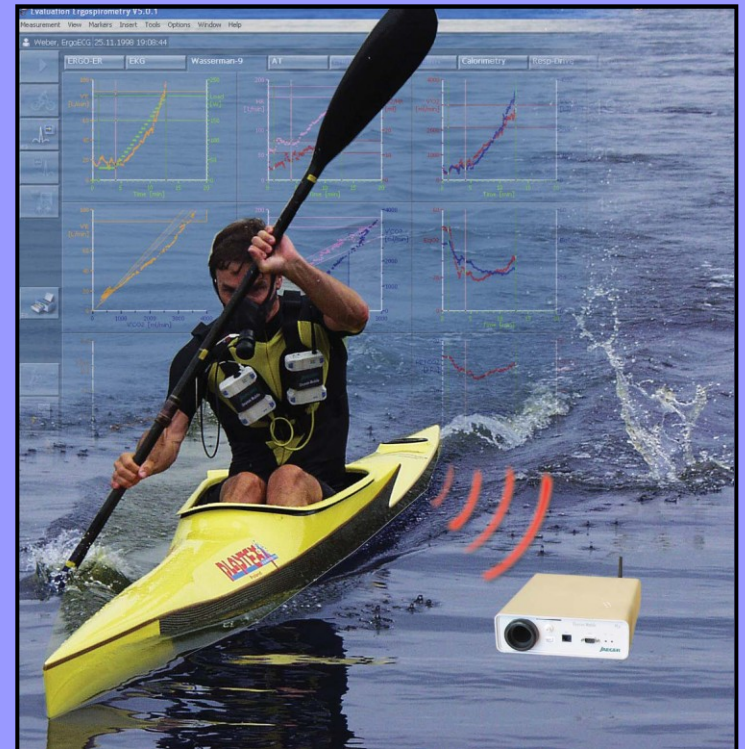


FIELD TESTS

DIAGNOSTICS
abilities

AEROBIC

ANAEROBIC



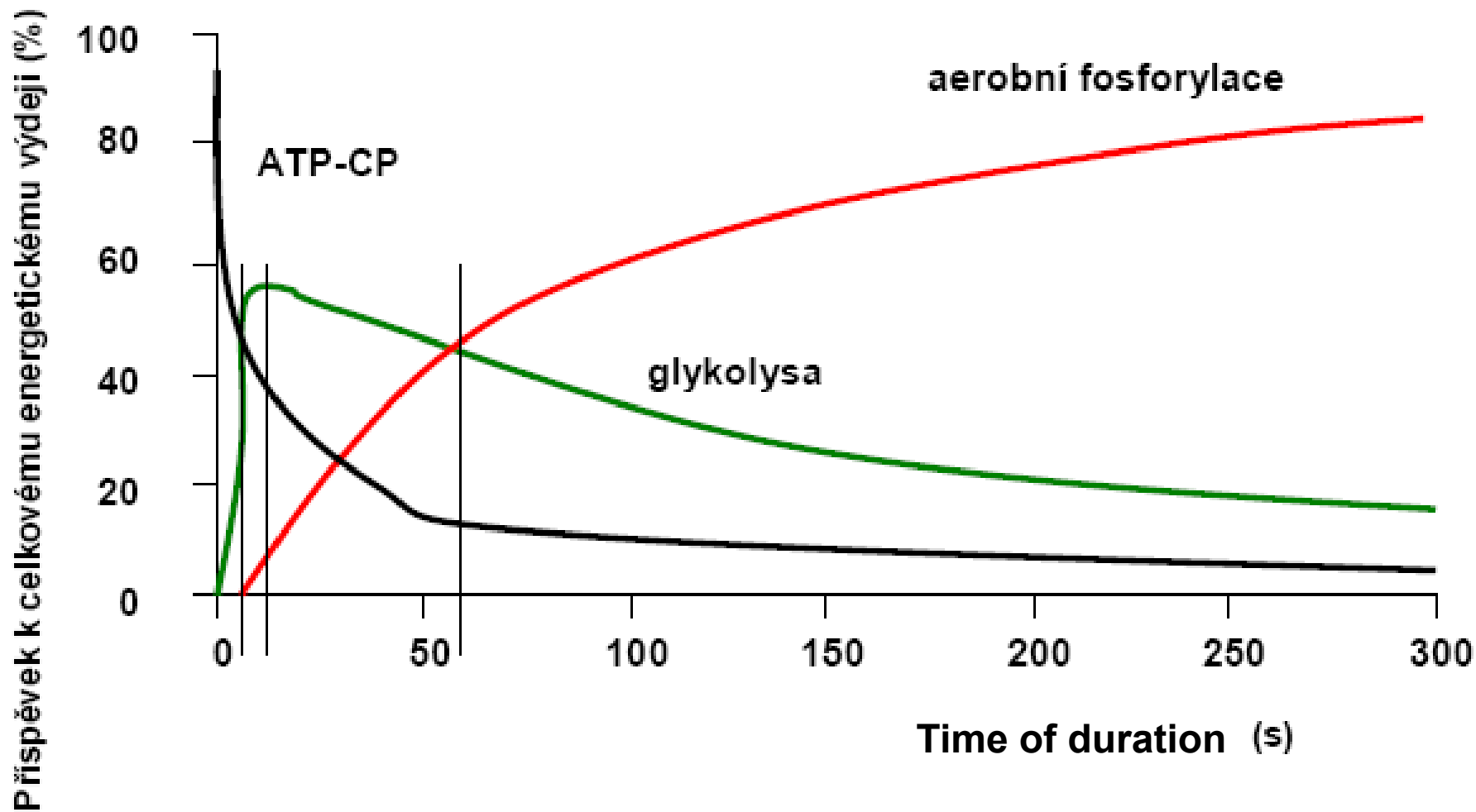
Anaerobic stress test

Wingate test

Bosco test (jump test)

(oxygen debt/EPOC)

Podíl jednotlivých energetických systémů na hrazení celkového energetického výdeje při různém trvání maximální zátěže (Stejskal 2006: zpracováno podle Gastina 2001).



ANAEROBIC TESTS

- ***aimed at assessing the ability to use non-oxidative (anaerobic) energy pathways for the synthesis of ATP in working muscle***

Základní vlastnosti sval. vláken (I, IIa, IIx)

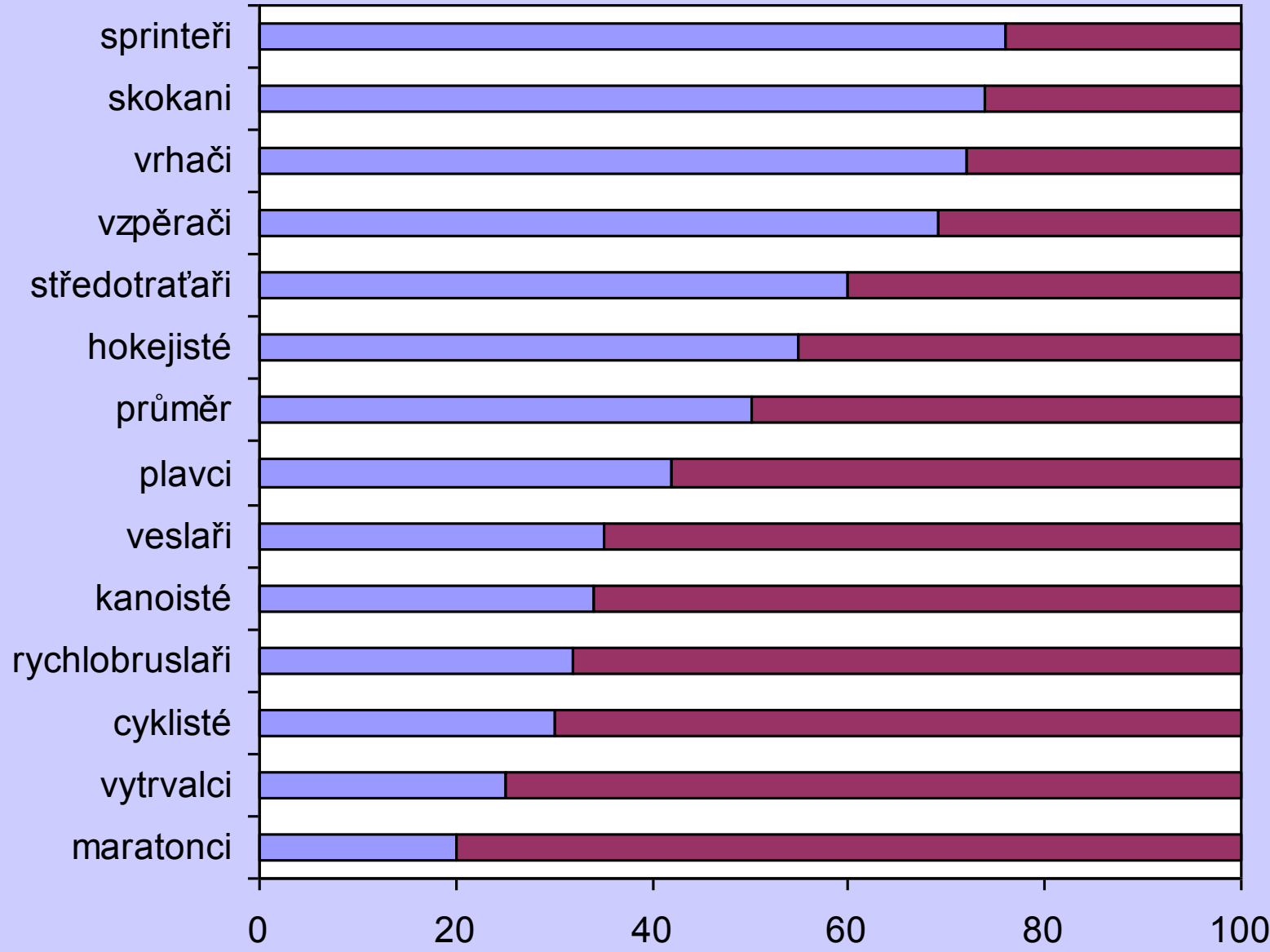
Typ I
pomalé červené

Typ IIa
rychlé červené

Typ IIx
rychlé bílé

| | | | |
|-----------------------|---------------|----------------|---------------|
| Rychlost kontrakce | pomalá | rychlá | rychlá |
| Síla kontrakce | nízká | střední | vysoká |
| Odolnost vůči únavě | vysoká | střední | nízká |
| Obsah glykogenu | nízký | vysoký | vysoký |
| Průměr | malý | střední | velký |
| Hustota mitochondrií | vysoká | vysoká | nízká |
| Hustota kapilár | vysoká | vysoká | nízká |
| Aktivita ATP-ázy | nízká | vysoká | vysoká |
| Glykolytická kapacita | nízká | vysoká | vysoká |

rychlá vlákna pomalá vlákna



Podíl vláken (%)

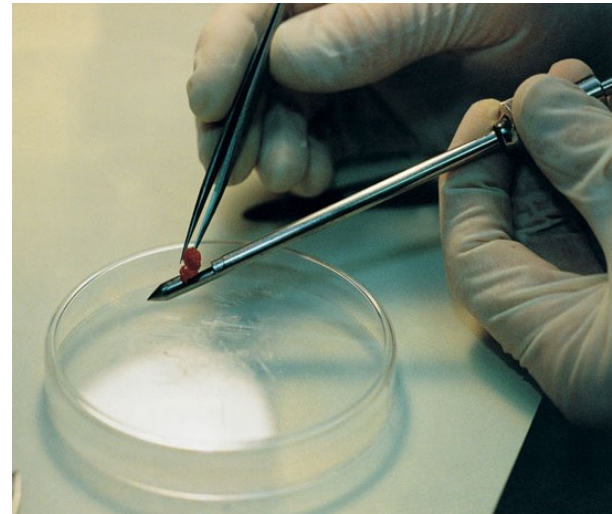
DIAGNOSTIKA svalových vláken

invazivní metoda – svalová biopsie

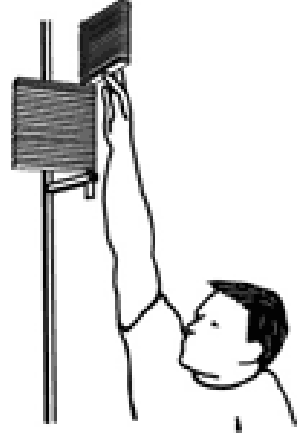
- ▶ magnetická rezonance se současnou analýzou biochemických parametrů snímaného svalu
- ▶ 1MR a následné cvičení s 80%
< 8 převaha II, 8-12 50%:50%, > 12 převaha I
- ▶ výskoková ergometrie

SVALOVÁ BIOPSIE

- ◆ Dutou jehlou je odebrán vzorek ze svalu.
- ◆ Vzorek se zmrazí, nakrájí na úzké plátky a zkoumá se pod mikroskopem.
- ◆ To umožňuje určit typ svalových vláken.



- Vertical Jump
- Step-running test (Margaria test)
- Test of anaerobic capacity – sprints on treadmill
- Isokinetic test
- EPOC/oxygen debt (oxygen deficit)
- Wingate test
- Výskoková ergometrie



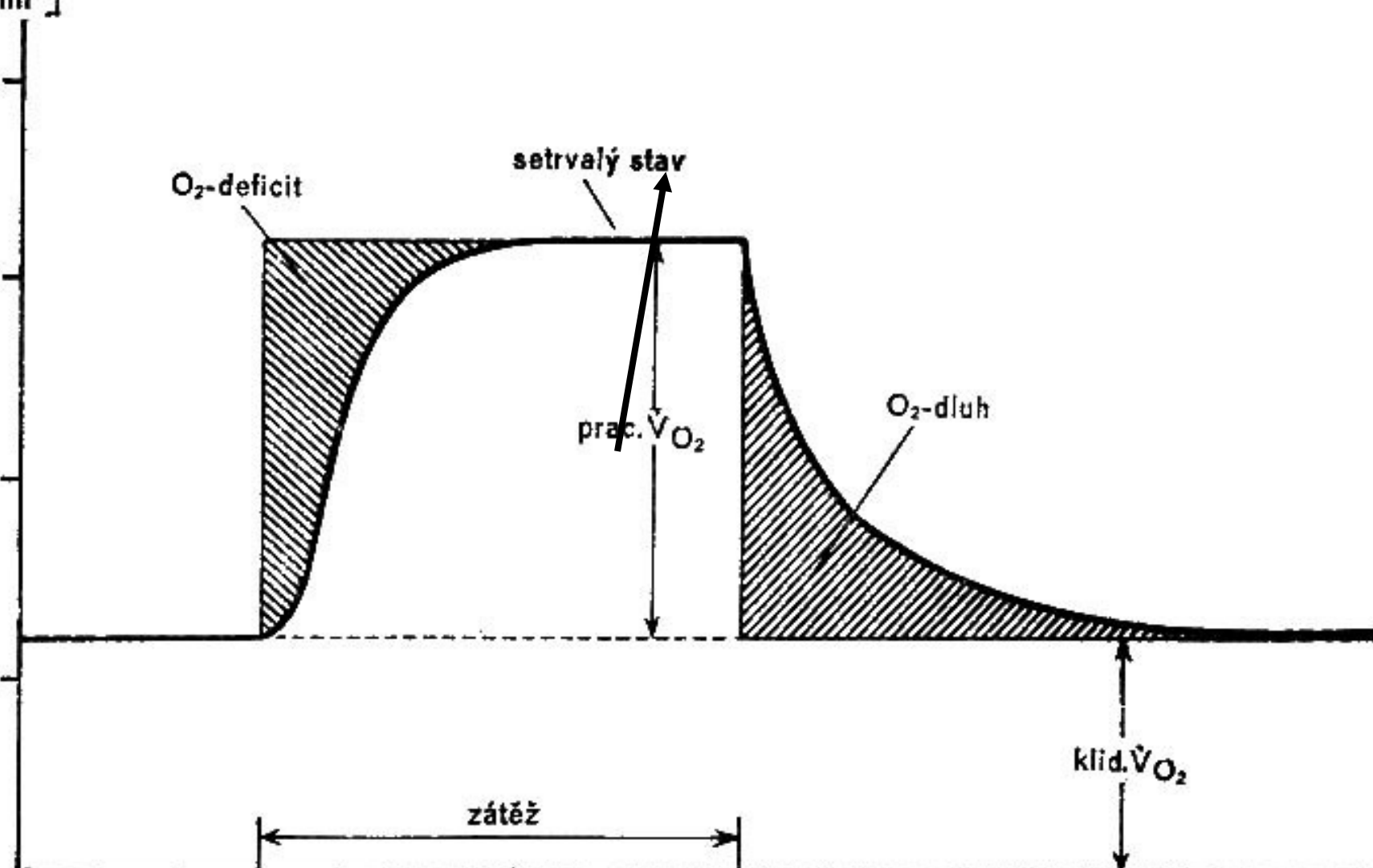
- **Maximální kyslíkový deficit** (maximal level of oxygen deficit) je teoretické množství kyslíku, které chybí (v průběhu maximální kontinuální zátěže do vyčerpání) do úrovně maximálního příjmu kyslíku [1]
- **Maximální kyslíkový dluh** (oxygen debt), maximální zotavovací kyslík je množství kyslíku, které převyšuje klidový příjem kyslíku (po skončení maximální zátěže do vyčerpání) [1]

$\dot{V}O_2$ [ml.min⁻¹]

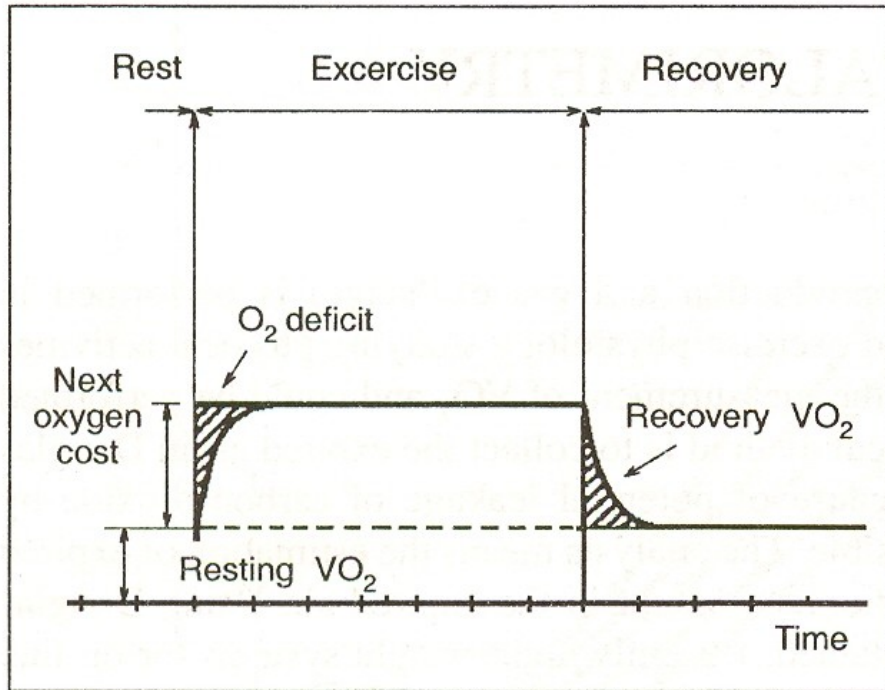
1000
750
500
250

-2 -1 0 1 2 3 4 5 6 1 2 3 4 5 6 7
 \bar{t} [min]

O₂-deficit
setrvalý stav
prac. $\dot{V}O_2$
O₂-dluh
zátěž
klid. $\dot{V}O_2$



Aerobic Exercise



Anaerobic Exercise

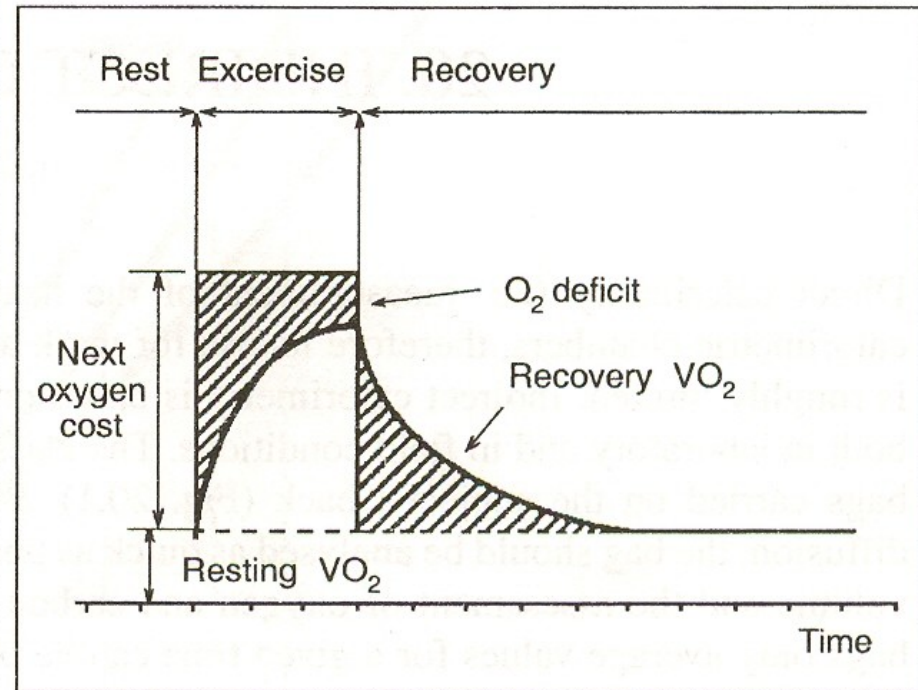


Fig. 20.2 Principle of indirect calorimetry, i.e. measurement of VO₂ at rest, during exercise and recovery.

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



Wingate test

(Wingate anaerobic test WAnT)

- is by far the most popular test of anaerobic performance
- the test involves pedalling for 30 seconds at supra-maximum effort, at a constant applied braking force
- optimal braking force is at about 6 w per kg of body mass



Wingate test - parameters

- **Peak power (PP)** output, which is the highest power output elicited during the test (averaged over 5-s period) – W, W/kg
- **Total work** generated during the 30-s test, i.e. **anaerobic capacity** (AnC), which is the product of the mean power and time (AnS [J] = MP [W] x 30) – J, J/kg
- **Power decrease**, i.e. the difference between the highest 5-s power output and the lowest 5-s power output, which is expressed relatively as a percentage of PP i.e. **fatigue index** (FI)
- In addition, peak heart rate (at the end of the test) and peak blood lactate (at 5th min of recovery) are often followed and used to the adequate interpretation of the results.

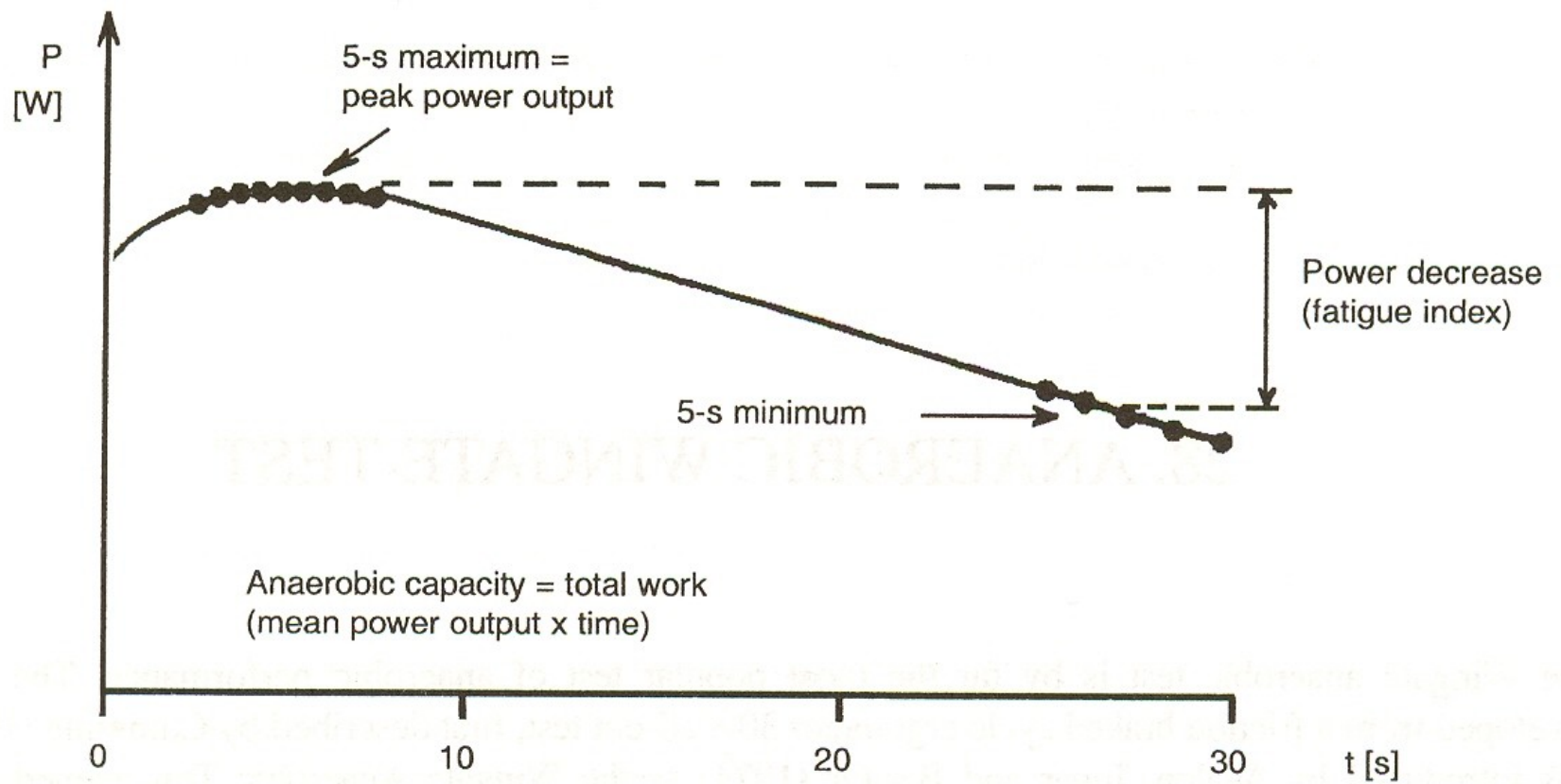


Fig. 28.1 Power output in the Wingate test and indices of the test.

Wingate test – average population (Lipková, 2006)

| | Peak power | | Mean power | |
|---------|------------|------|------------|------|
| | W | W/kg | W | W/kg |
| Males | 700 | 9,2 | 563 | 7,3 |
| Females | 454 | 7,6 | 381 | 6,4 |

Wingate test – female athletes

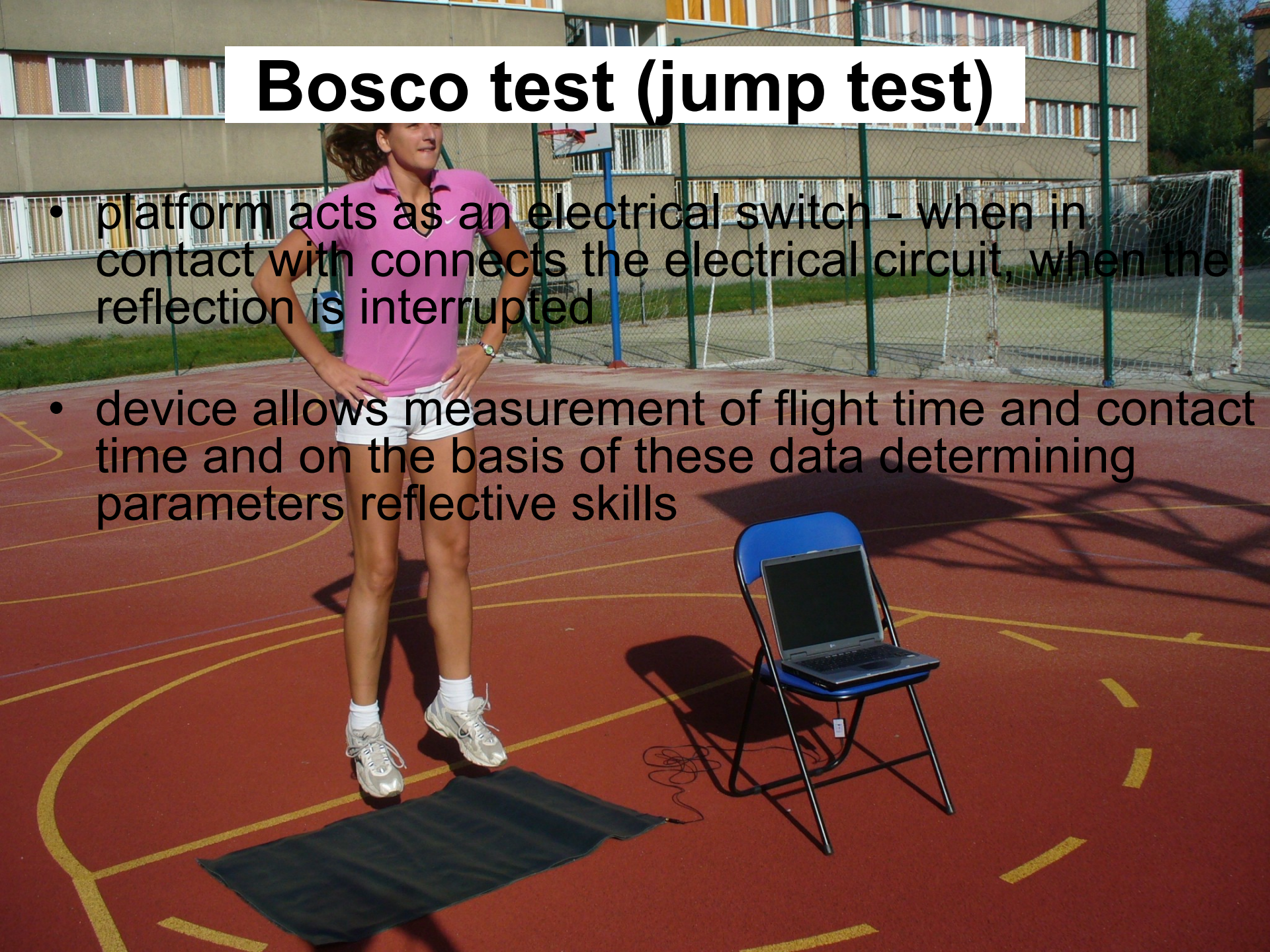
| | Maximální výkon | | Anae. kapacita | Index únavy | Zdroj |
|-------------|-----------------|------|----------------|-------------|---------------------|
| | W | W/kg | J/kg | % | Autor, rok |
| sprint | - | 11,4 | 272 | 37 | Heller, 1999 |
| Ice-hockey | 785 | - | - | - | Hoffman, 2006 |
| swimming | - | 10,8 | 265 | 34 | Heller, 1999 |
| skating | - | 12,3 | - | - | Smith-Roberts, 1991 |
| tenis | 699 | - | - | - | Kraemer, 2003 |
| PE students | | 10,8 | 258 | 40 | Heller, 1999 |

Wingate test – male athletes

| | Maximální výkon | | Anae. kapacita | Index únavy | Zdroj |
|---------------------|-----------------|---------------|----------------|-------------|--------------------------------|
| | W | W/kg | J/kg | % | Autor, rok |
| 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 |
| mid-distance runing | - | 10,0* 13,0 | - | - | Lipková, 2006* Granier 1995 |
| basketball | - | 14,4 | - | - | Hoffman, 1999 |
| endurance runing | - | 9,3 | - | - | Lipková, 2006 |
| PE students | | 12,3 | 292 | 46 | Heller, 1999 |

Bosco test (jump test)

- platform acts as an electrical switch - when in contact with connects the electrical circuit, when the reflection is interrupted
- device allows measurement of flight time and contact time and on the basis of these data determining parameters reflective skills



Bosco test (60-s vertical test)

- the test consists of performing consecutive maximum vertical jumps during a 60-s period
- the subject must jump continuously with maximum effort with knees bent to about 90° and the hands kept on hips to minimise lateral and horizontal displacement
- during the test, the time in contact with the platform and the flight time recorded and summed over the 60-s period

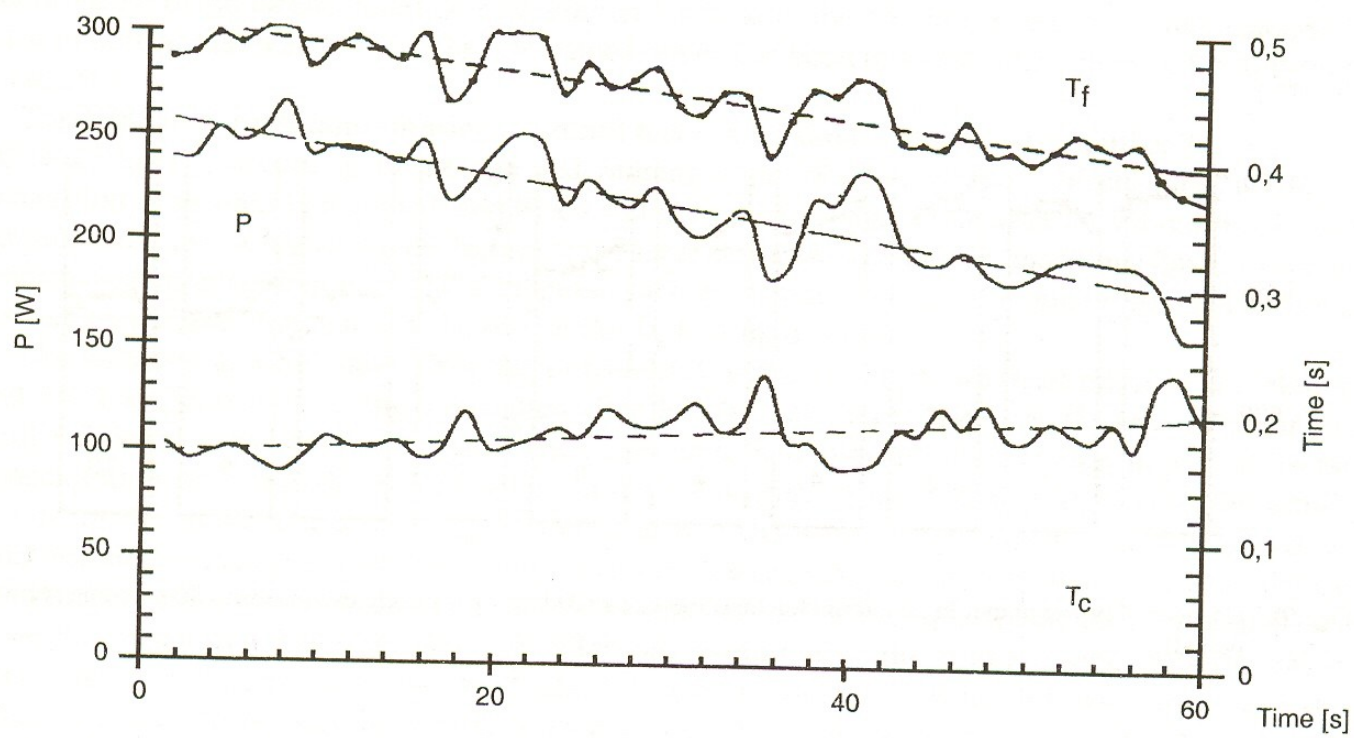
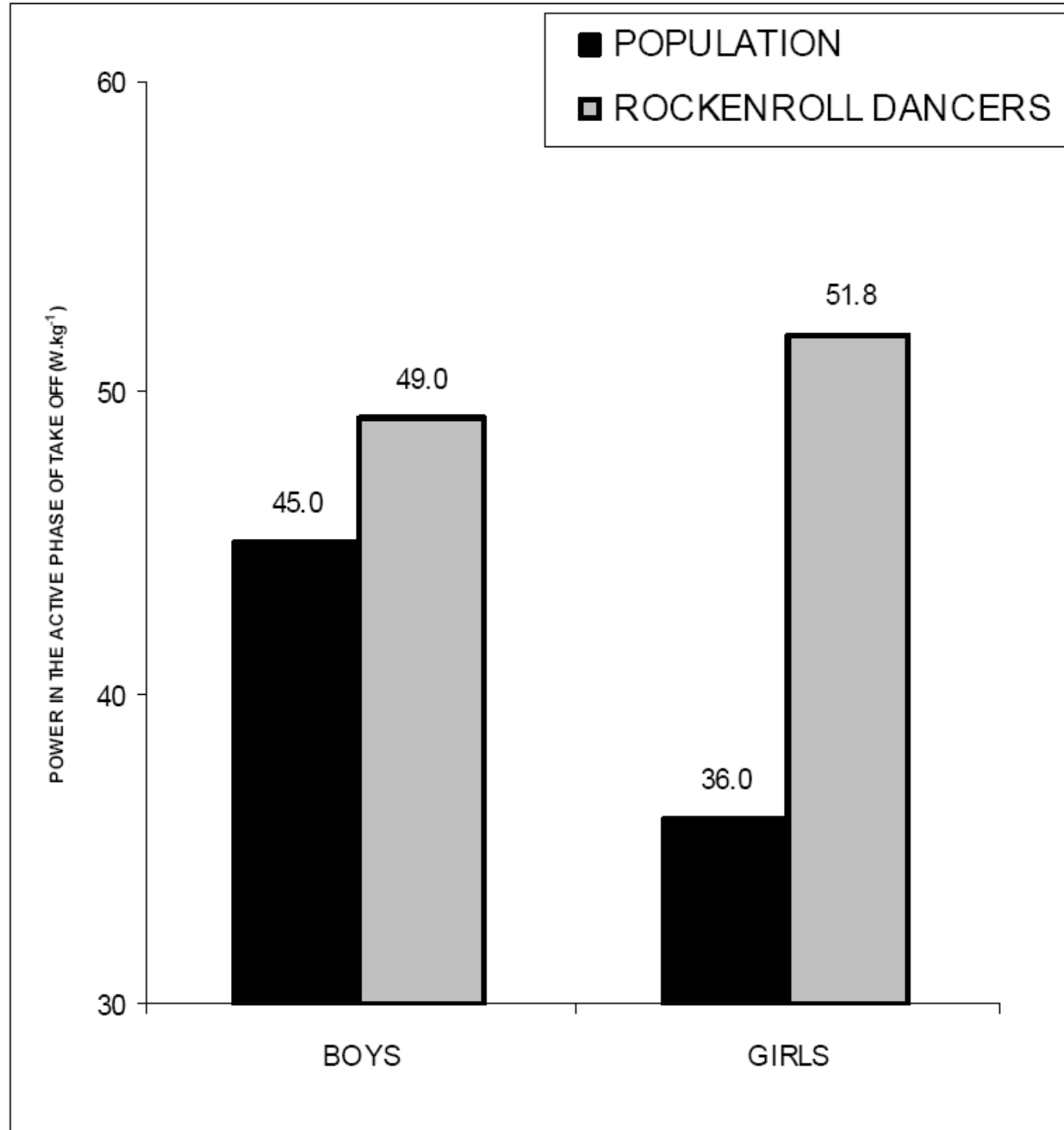
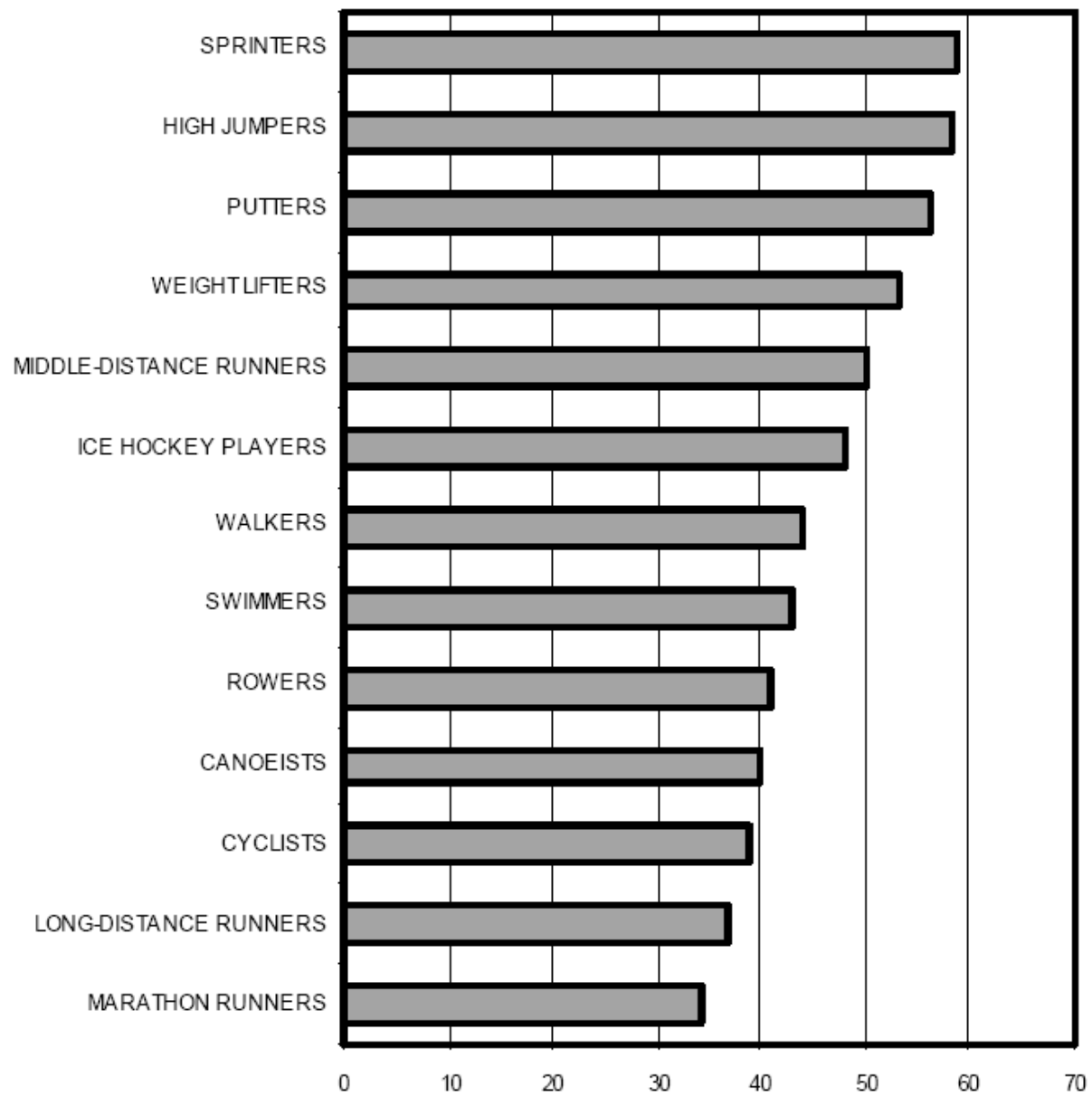


Fig. 30.2 Example of a 60-s Bosco test. Flight time (T_f) and power output (P) decrease and contact time (T_c) inversely increases throughout the 60-s test.

Table 30.2 Typical values of flight time (T_f), contact time (T_c), average power (P) and blood lactate (LA) in the 60-s Bosco test (Heller et al., unpublished data).

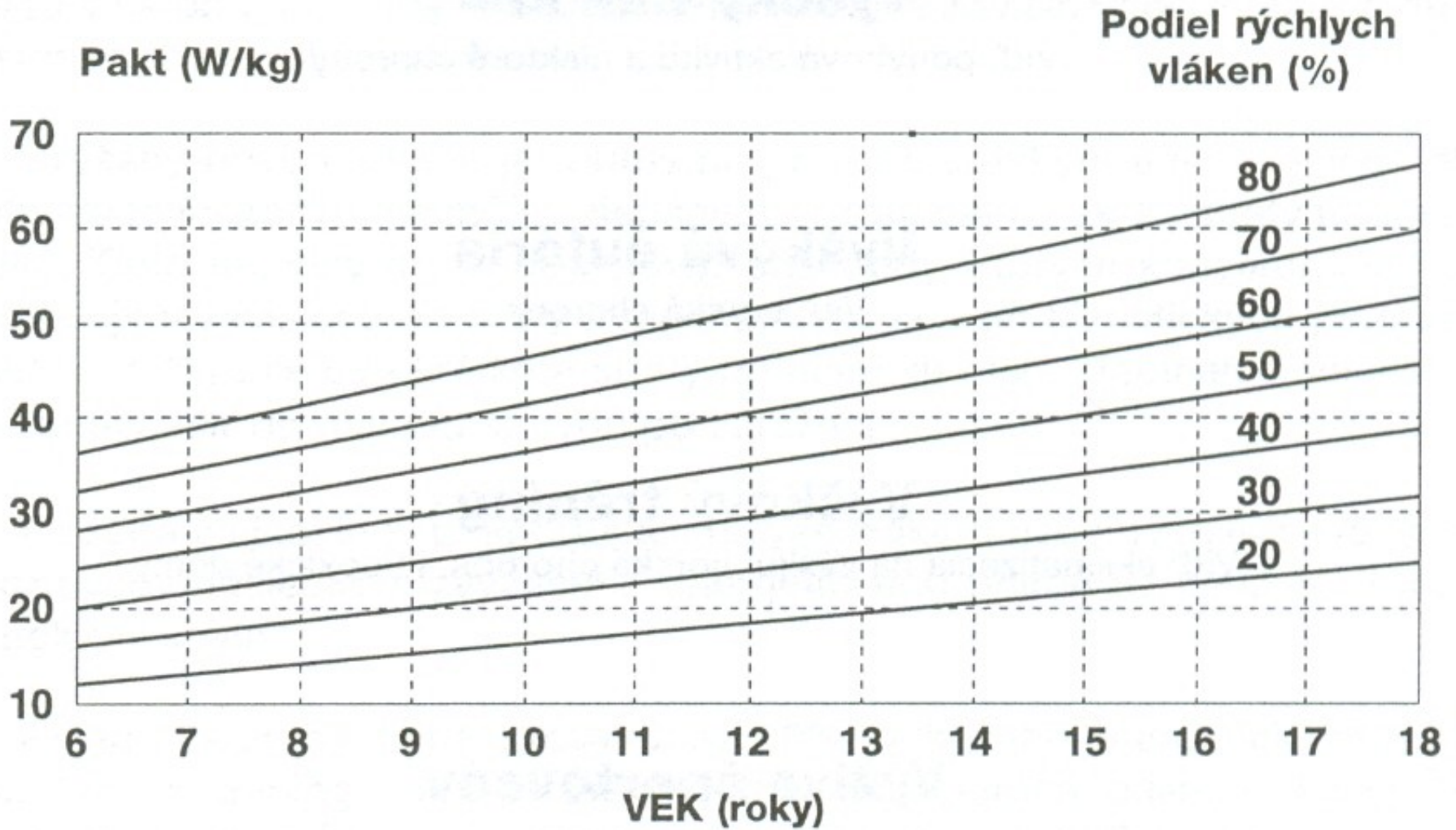
| | Age [y] | T_f [s] | T_c [s] | P [W] | P [W.kg ⁻¹] | LA [mmol.l ⁻¹] |
|-----------------------|---------|-----------|-----------|---------|---------------------------|----------------------------|
| Males | | | | | | |
| Karate | 22 | 40.3 | 19.7 | 224 | 3.51 | 11.1 |
| Taekwon-do | 16 | 41.3 | 18.7 | 225 | 3.69 | 10.8 |
| Skialpinism | 26 | 40.9 | 19.1 | 214 | 2.94 | 10.9 |
| Females | | | | | | |
| Taekwon-do | 18 | 40.4 | 19.6 | 209 | 3.40 | 8.4 |
| Volleyball – jun. | 18 | 39.5 | 20.5 | 265 | 3.72 | 9.4 |
| Volleyball – national | 23 | 40.1 | 19.9 | 288 | 3.91 | 7.4 |



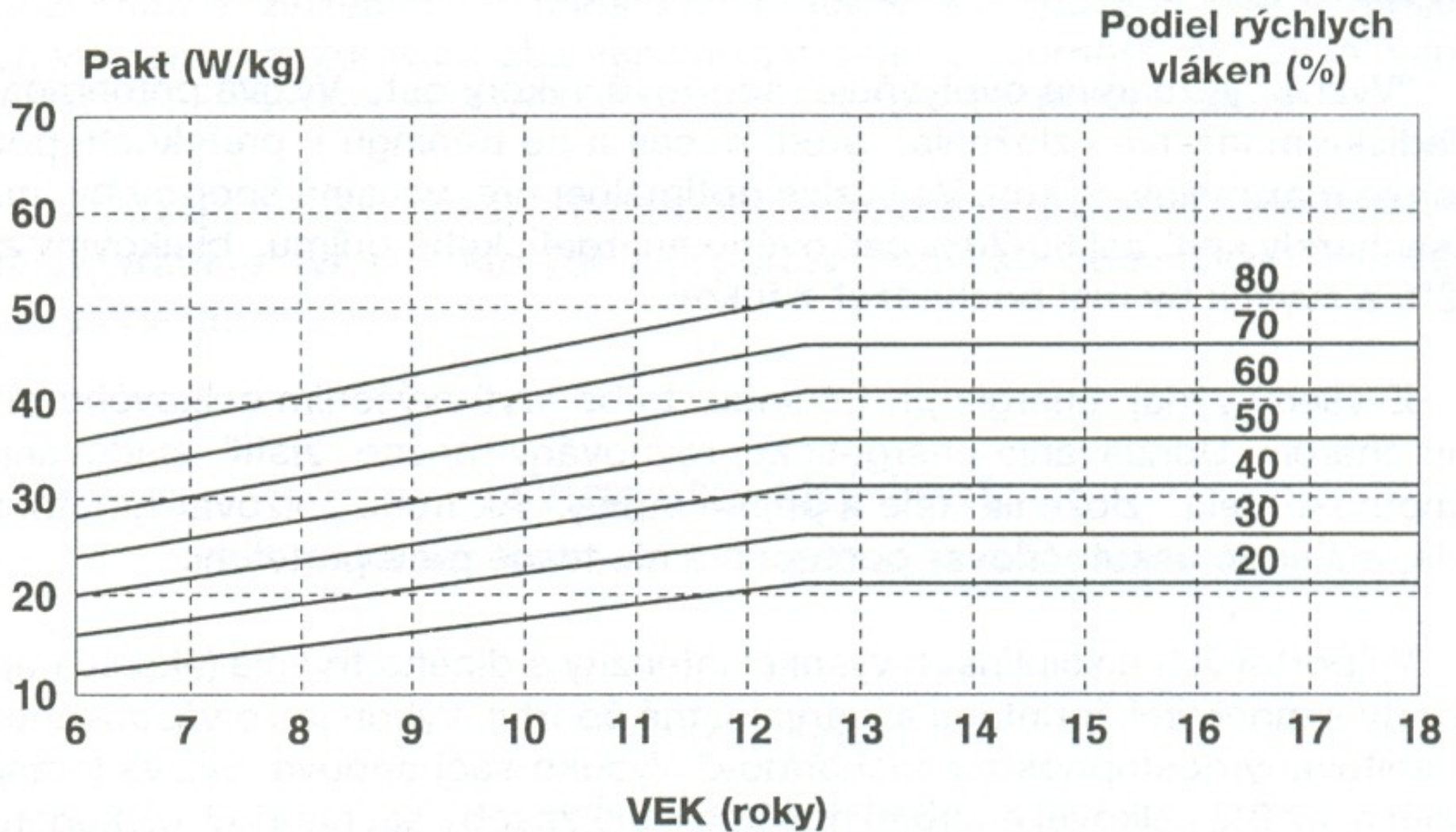


POWER IN THE ACTIVE PHASE OF TAKE OFF (W.kg⁻¹)

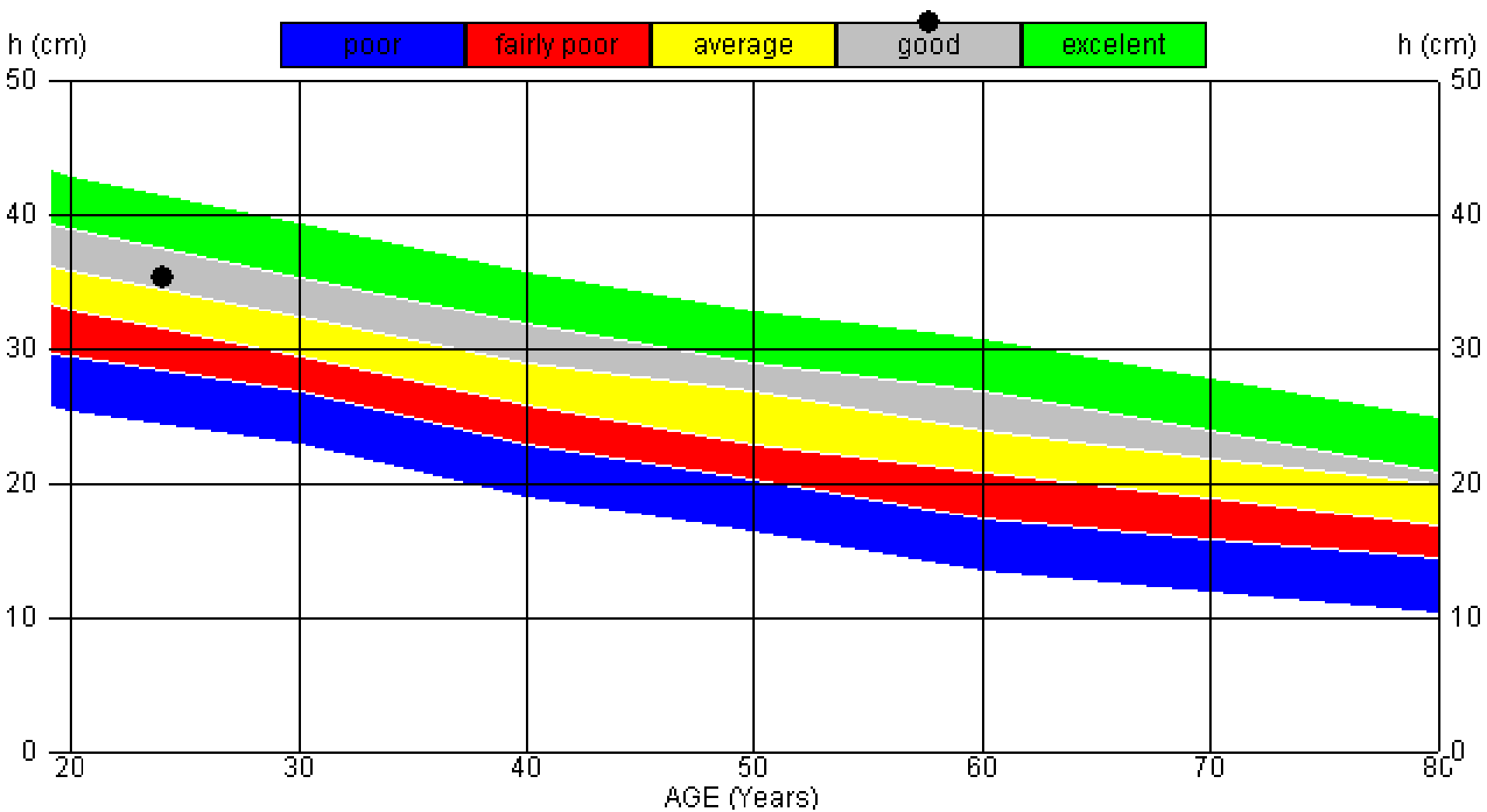
BOYS



GIRLS



MALES



FEMALES

