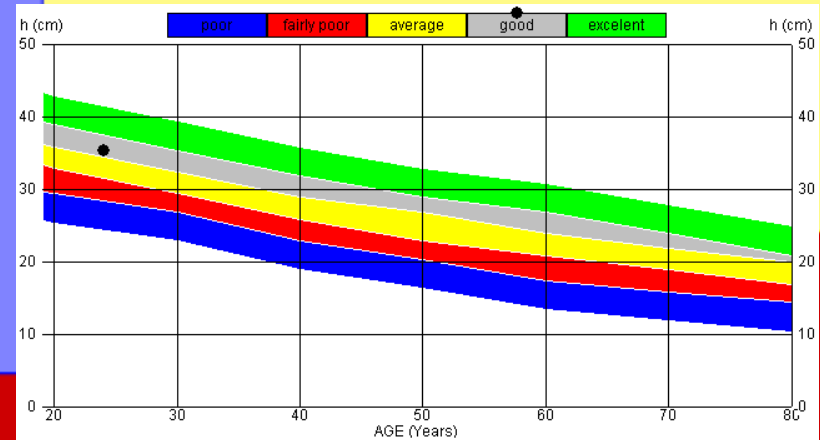


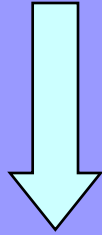


# STRESS TESTS

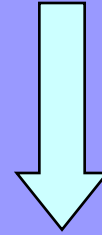
## ANAEROBIC TESTS



# STRESS TESTS



LABORATORY TESTS

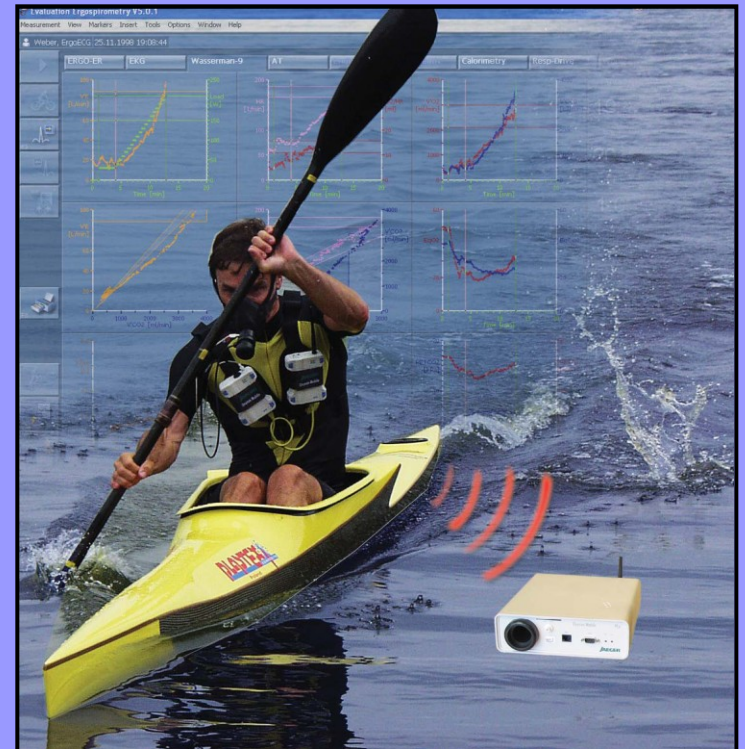


FIELD TESTS

DIAGNOSTICS  
abilities

AEROBIC

ANAEROBIC



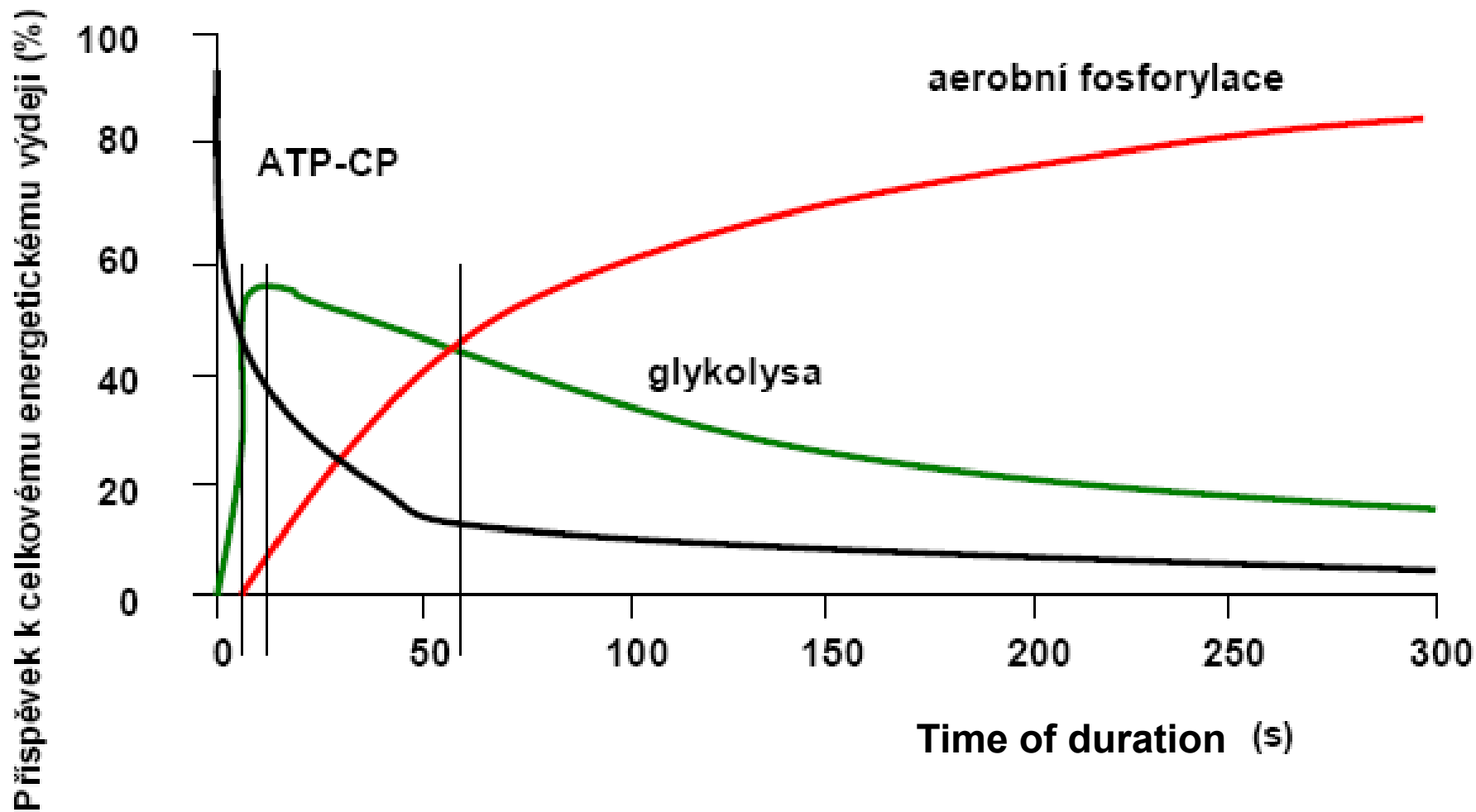
# Anaerobic stress test

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)

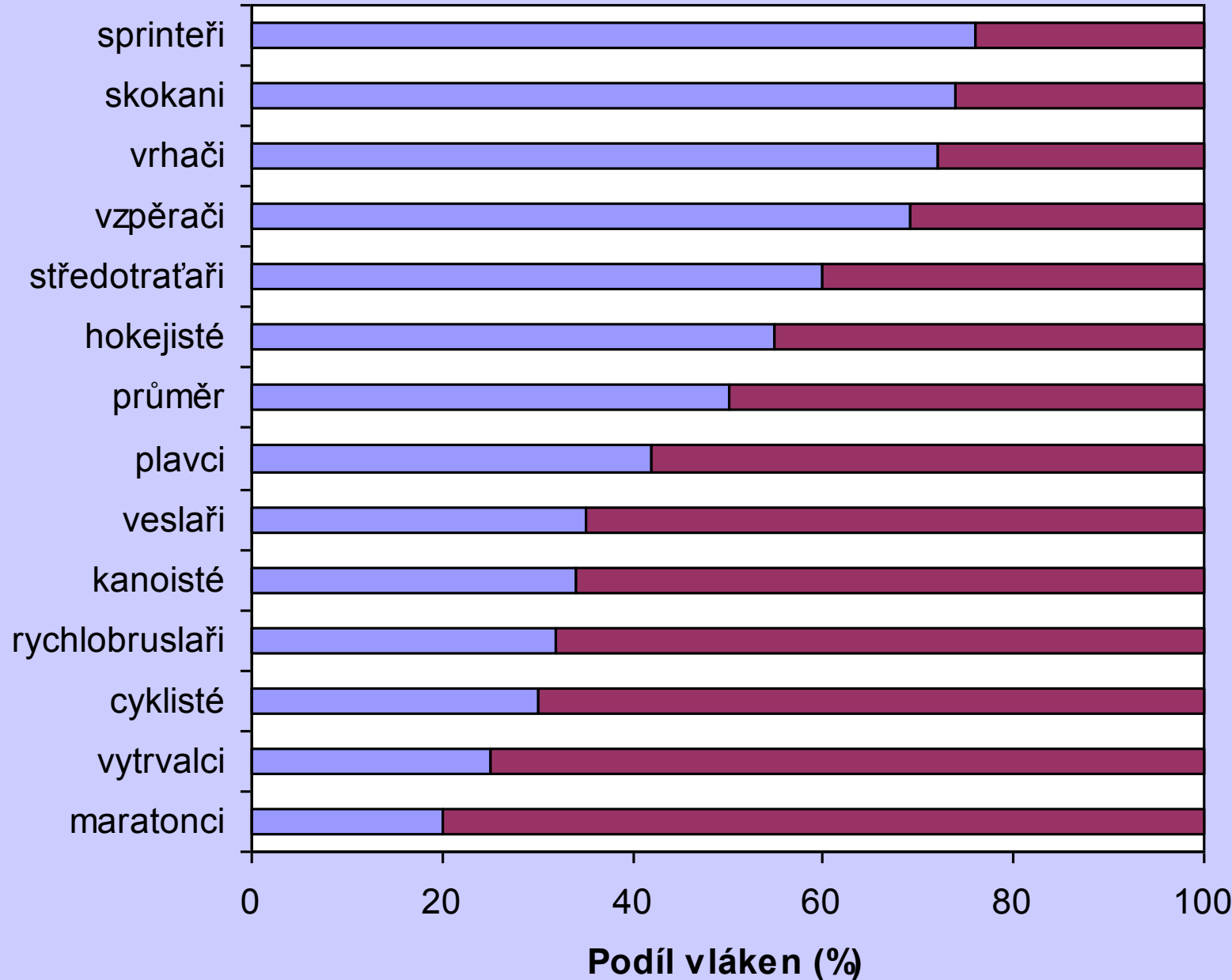
Typ I  
pomalé červené

Typ IIa  
rychlé červené

Typ IIx  
rychlé bílé

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

rychlá vlákna pomalá vlákna



# DIAGNOSTIKA svalových vláken

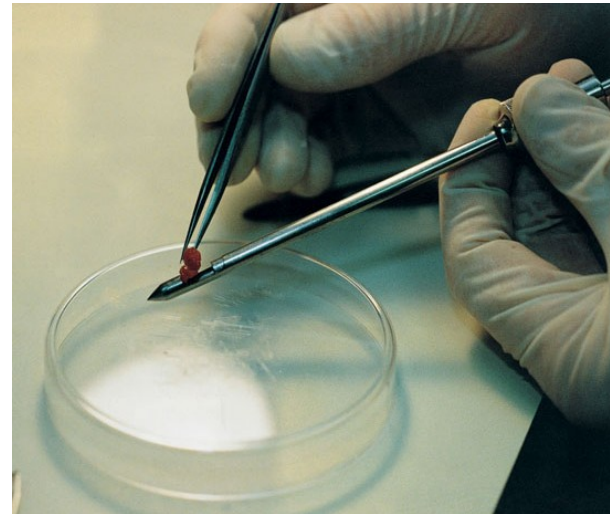
invazivní metoda – svalová biopsie

- ▶ 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

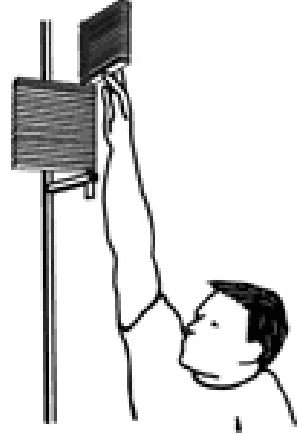


# SVALOVÁ BIOPSIE

- ◆ 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



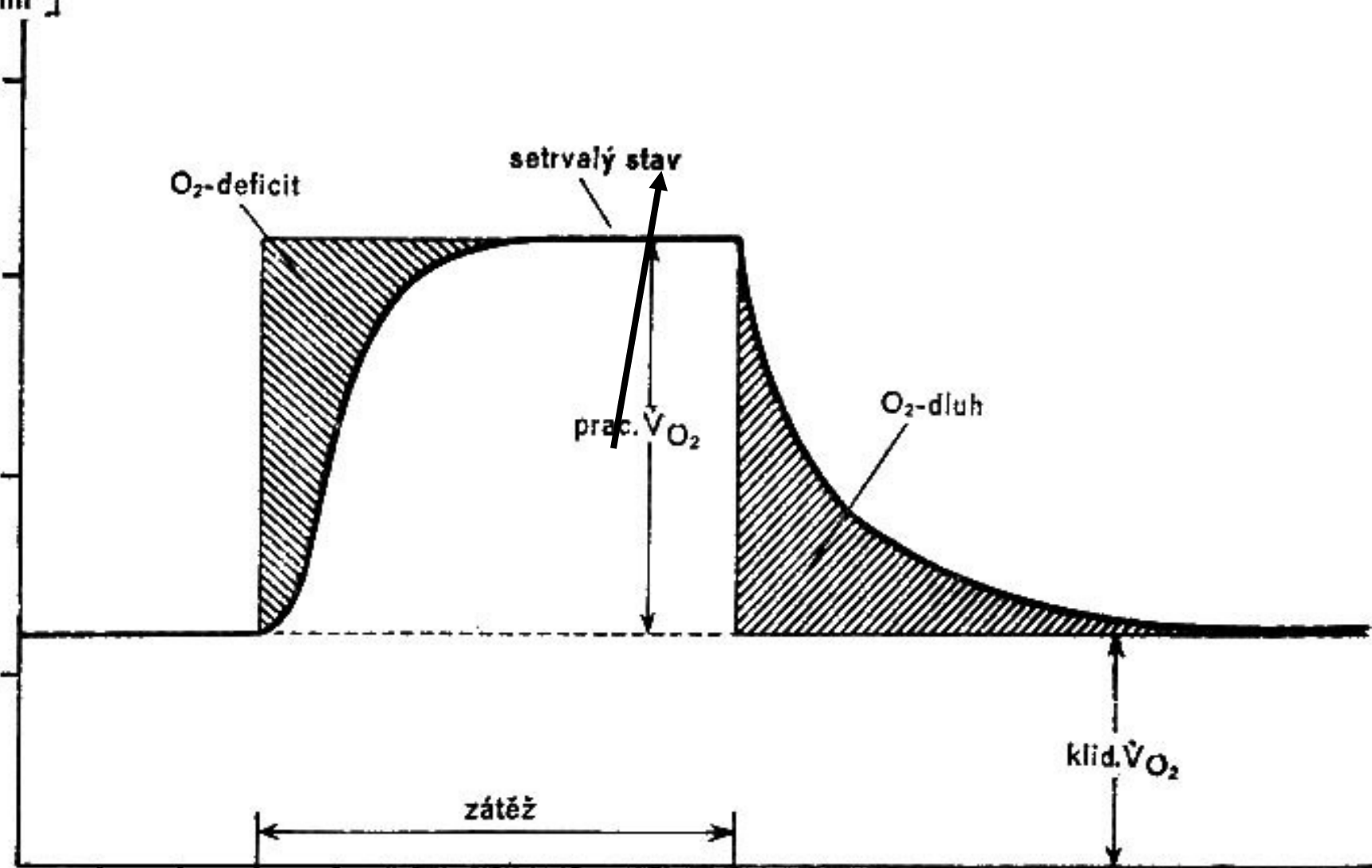
- **Maximální kyslíkový deficit** (maximal level of oxygen deficit) je teoretické množství kyslíku, které chybí (v průběhu maximální kontinuální zátěže do vyčerpání) do úrovně maximálního příjmu kyslíku [1]
- **Maximální kyslíkový dluh** (oxygen debt), maximální zotavovací kyslík je množství kyslíku,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

$\dot{V}O_2$  [ml.min<sup>-1</sup>]

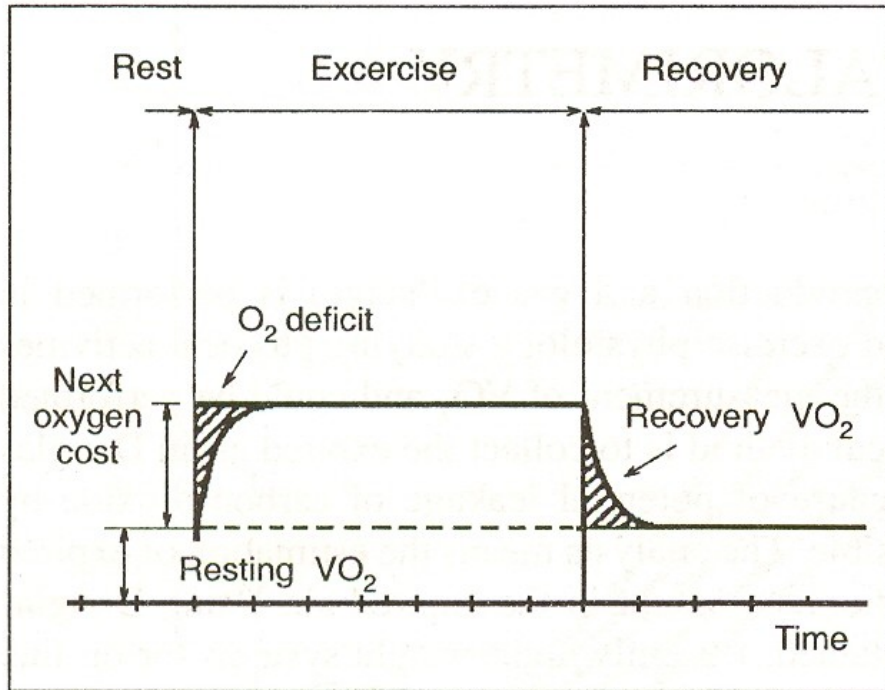
1000  
750  
500  
250

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

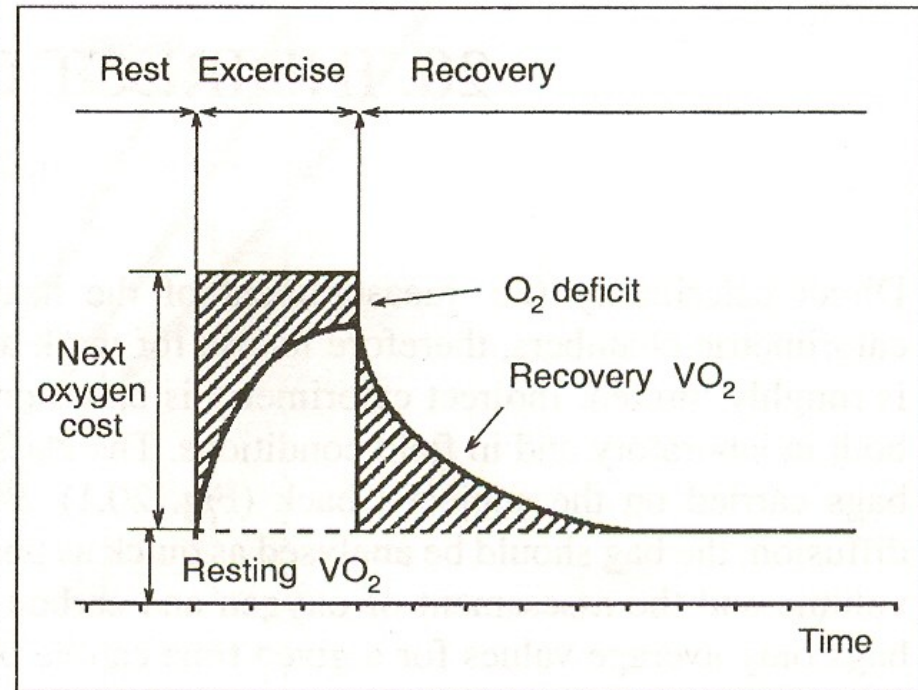
O<sub>2</sub>-deficit  
setrvalý stav  
prac.  $\dot{V}O_2$   
O<sub>2</sub>-dluh  
klid.  $\dot{V}O_2$   
zátěž



### Aerobic Exercise



### Anaerobic Exercise



**Fig. 20.2** Principle of indirect calorimetry, i.e. measurement of VO<sub>2</sub> 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.



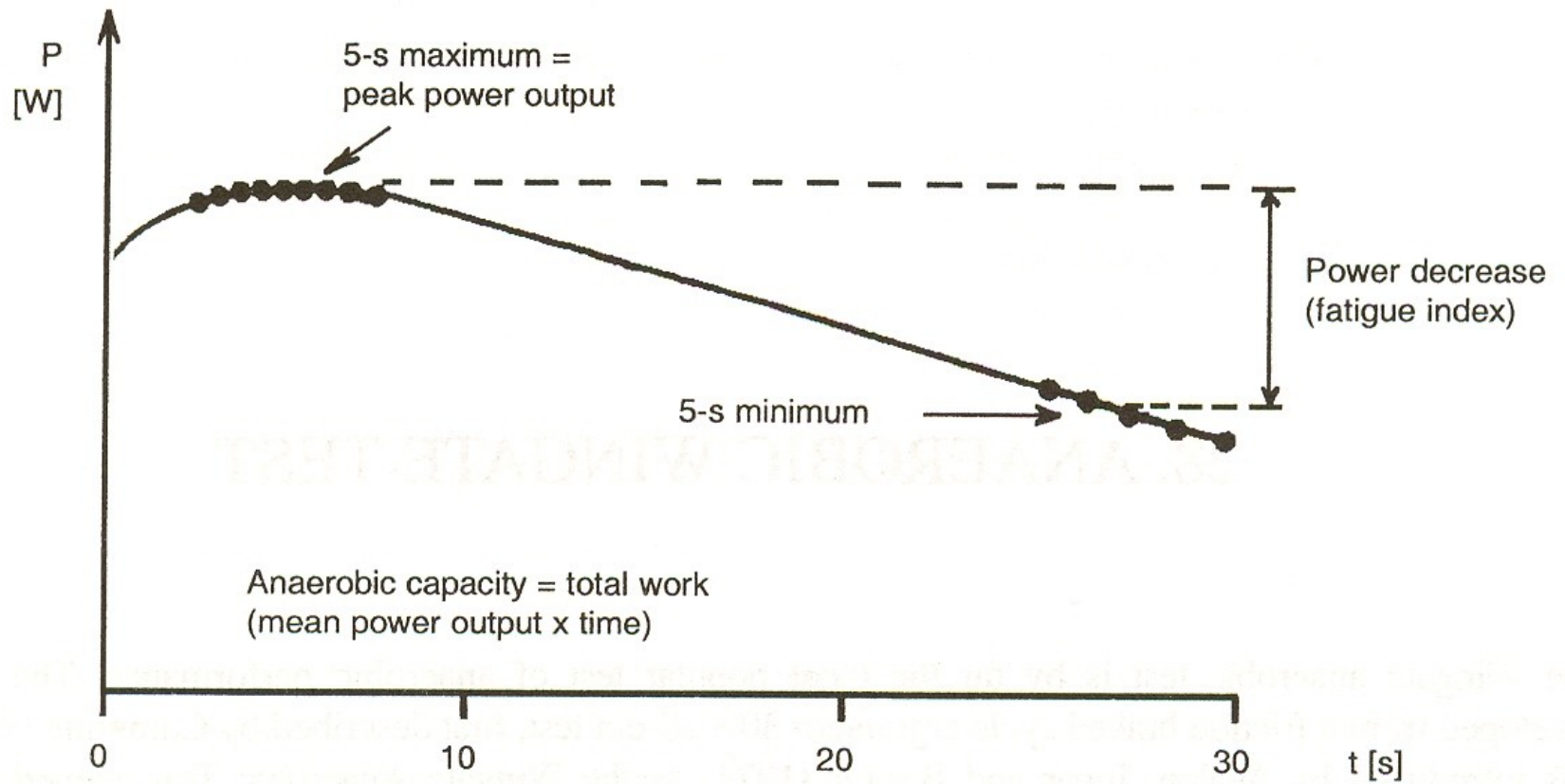


Fig. 28.1 Power output in the Wingate test and indices of the test.

# 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

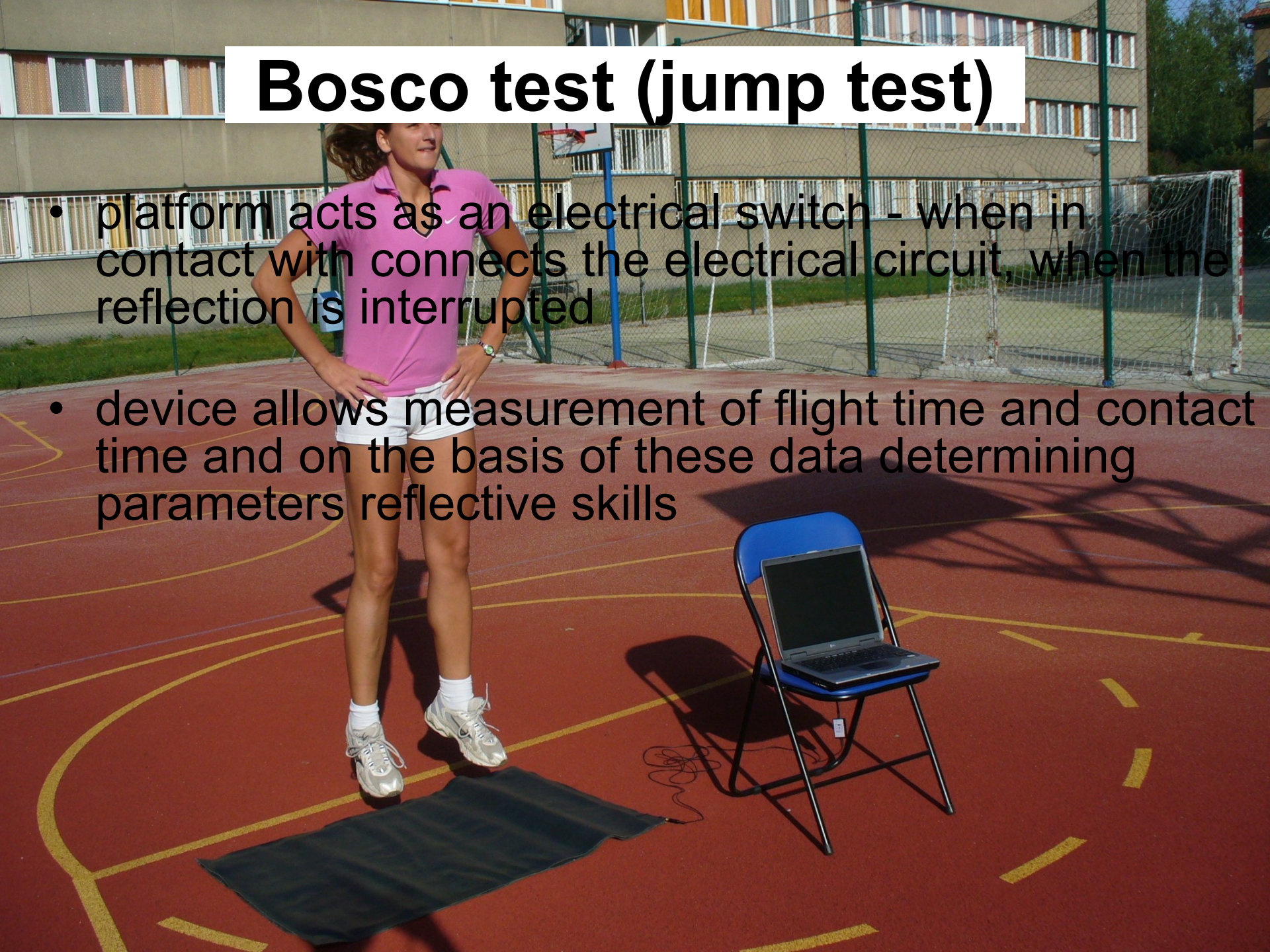
# Wingate test – male athletes

	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

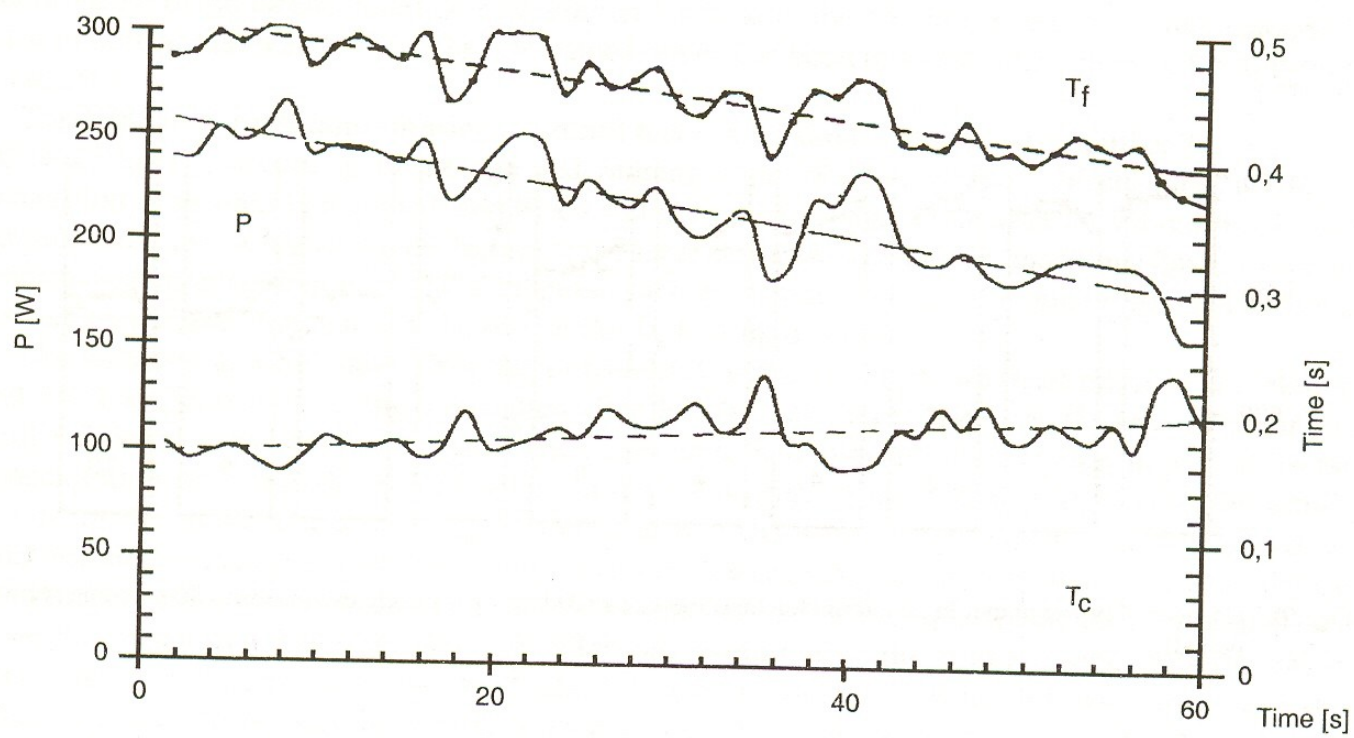


# **Bosco test** (60-s vertical test)

- 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  $90^\circ$  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





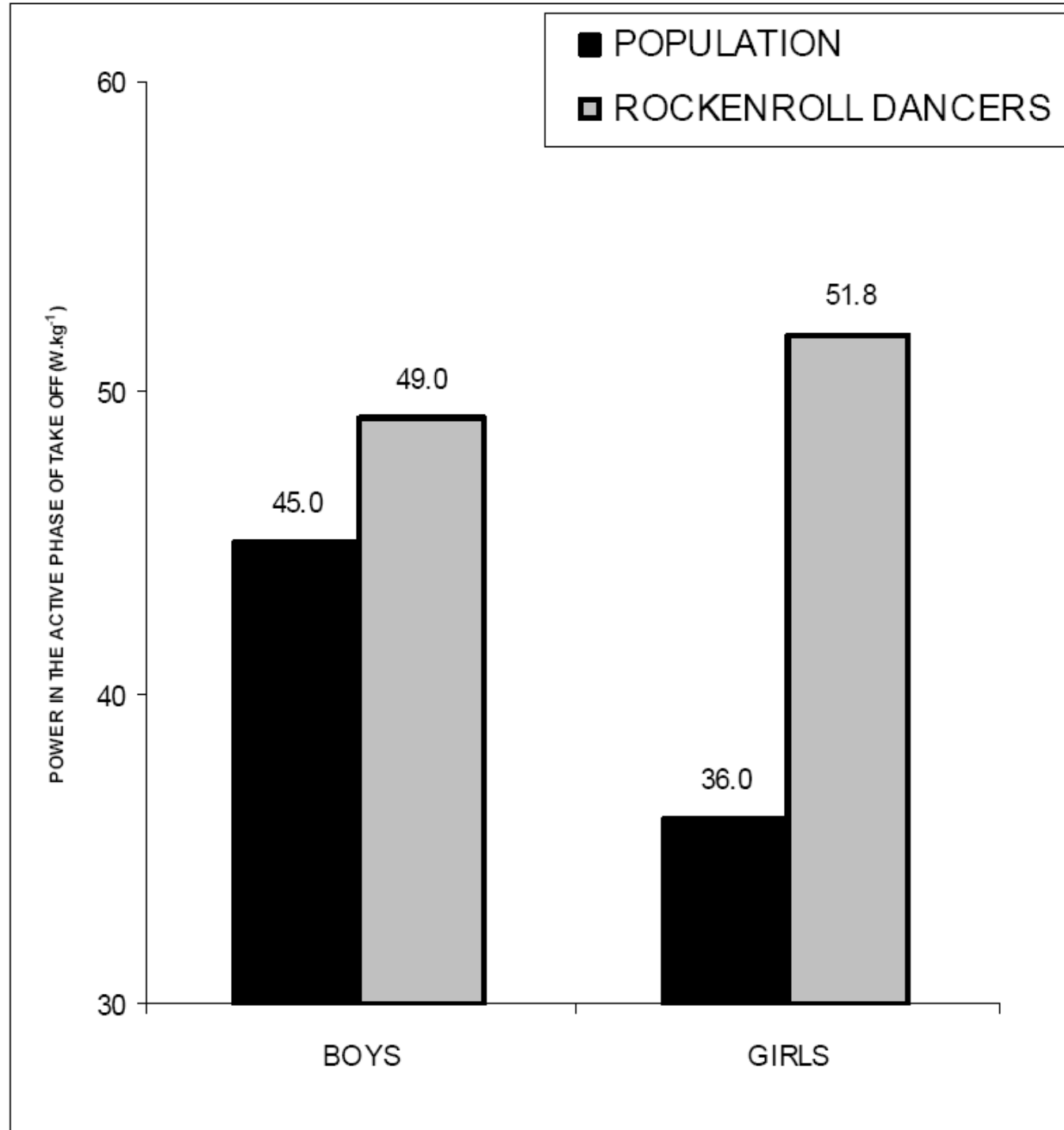


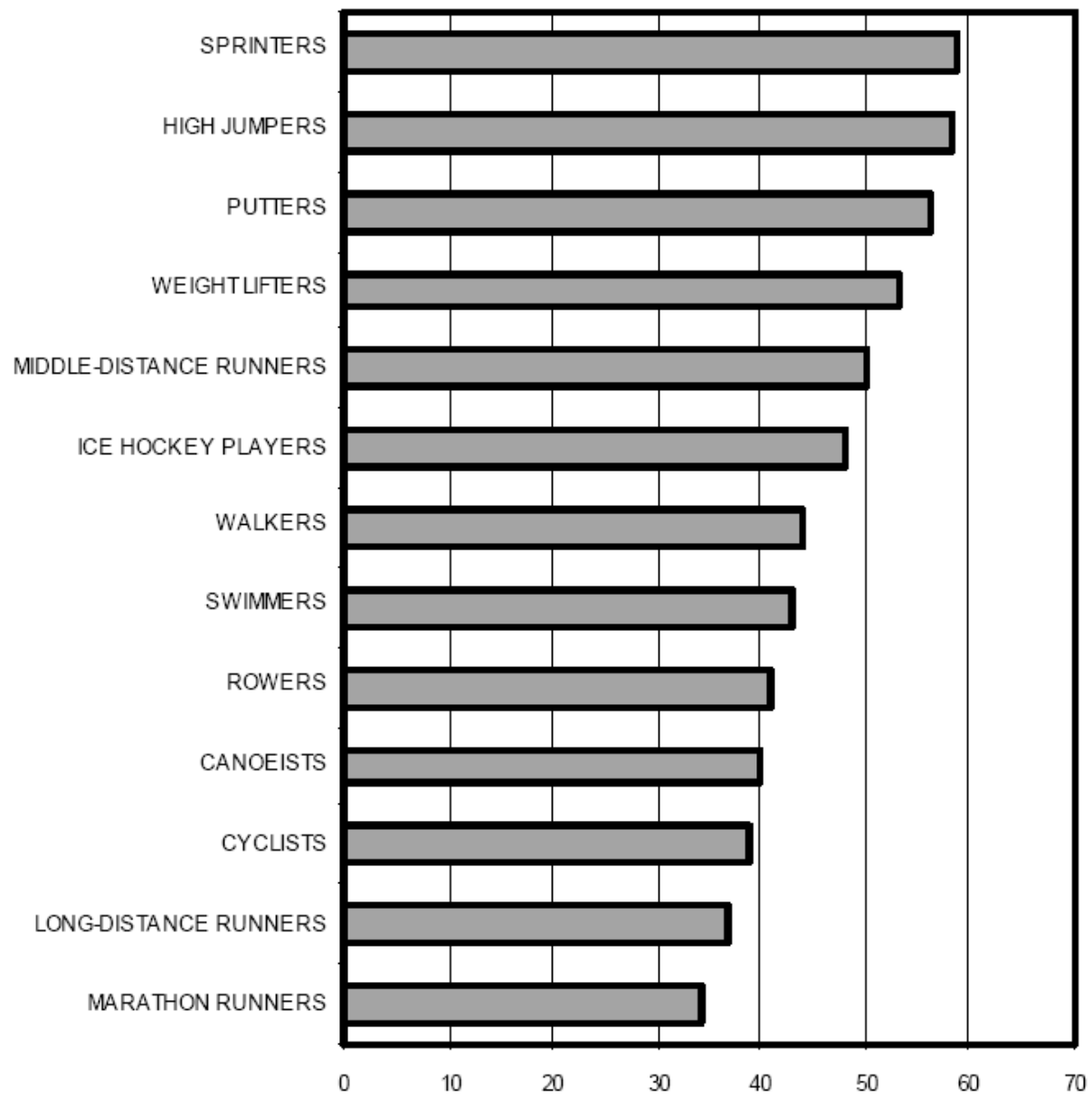
**Fig. 30.2** Example of a 60-s Bosco test. Flight time ( $T_f$ ) and power output ( $P$ ) decrease and contact time ( $T_c$ ) inversely increases throughout the 60-s test.

**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 <sup>-1</sup> ]	LA [mmol.l <sup>-1</sup> ]
<b>Males</b>						
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
<b>Females</b>						
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

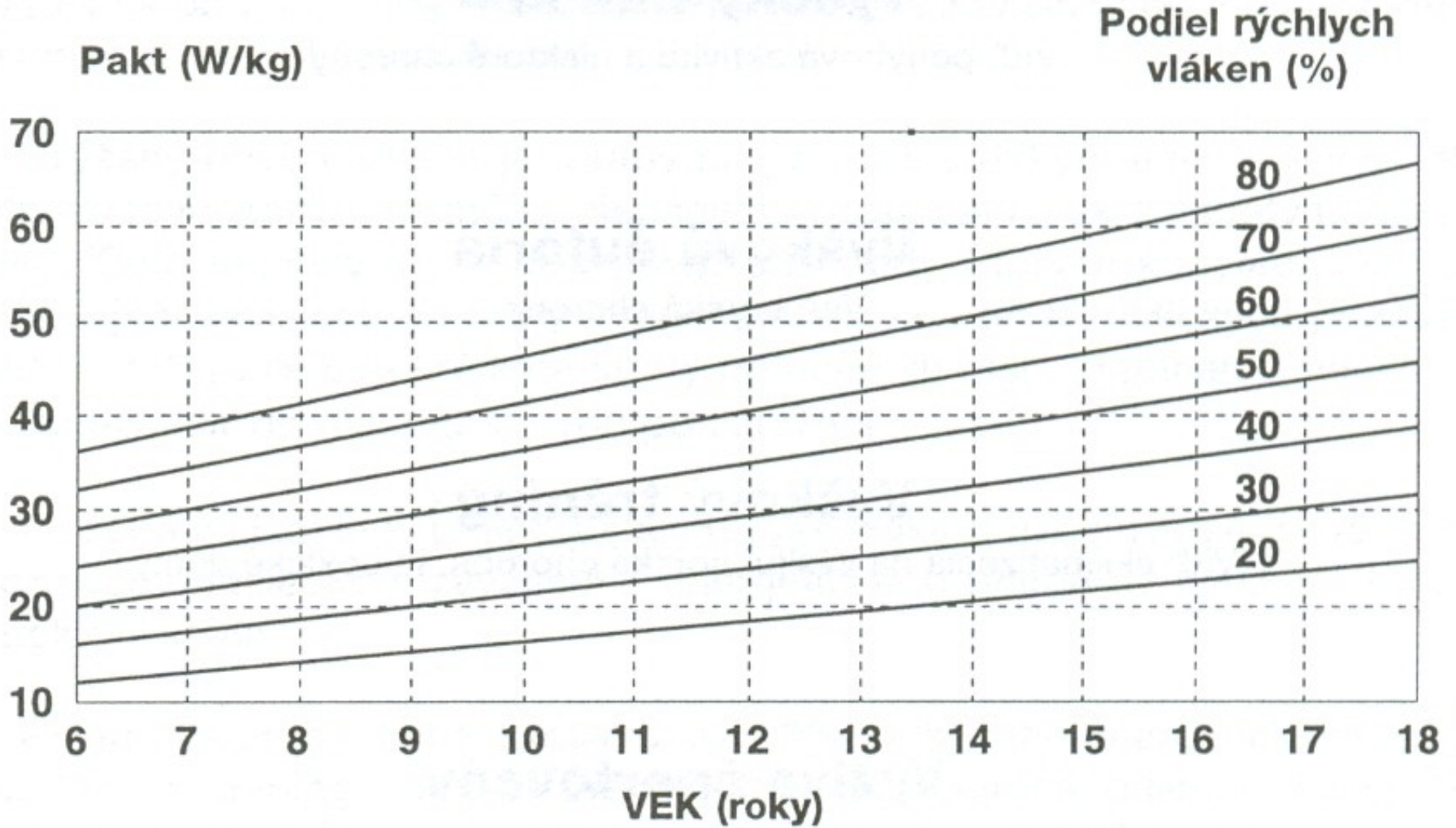




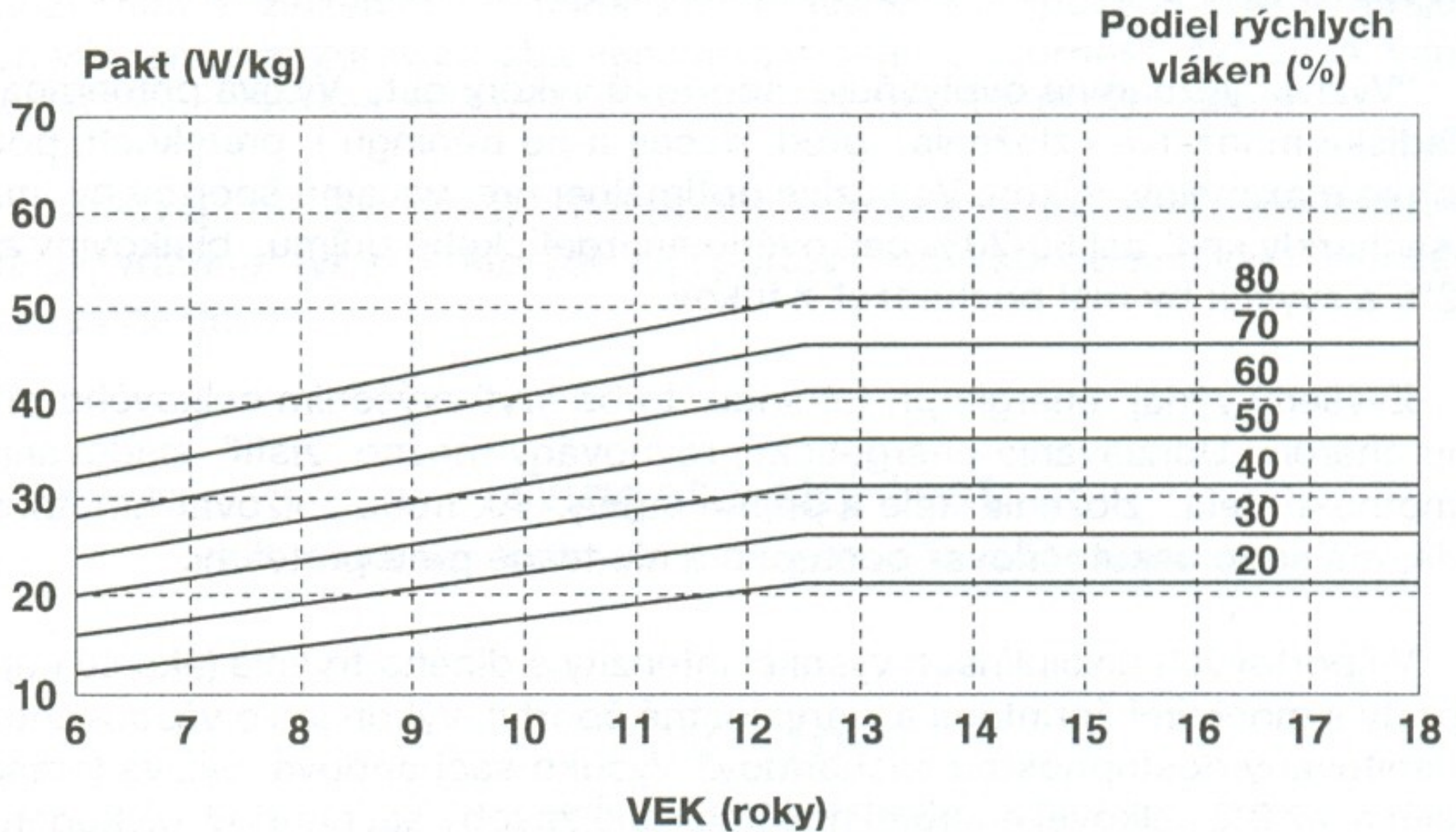


POWER IN THE ACTIVE PHASE OF TAKE OFF (W.kg<sup>-1</sup>)

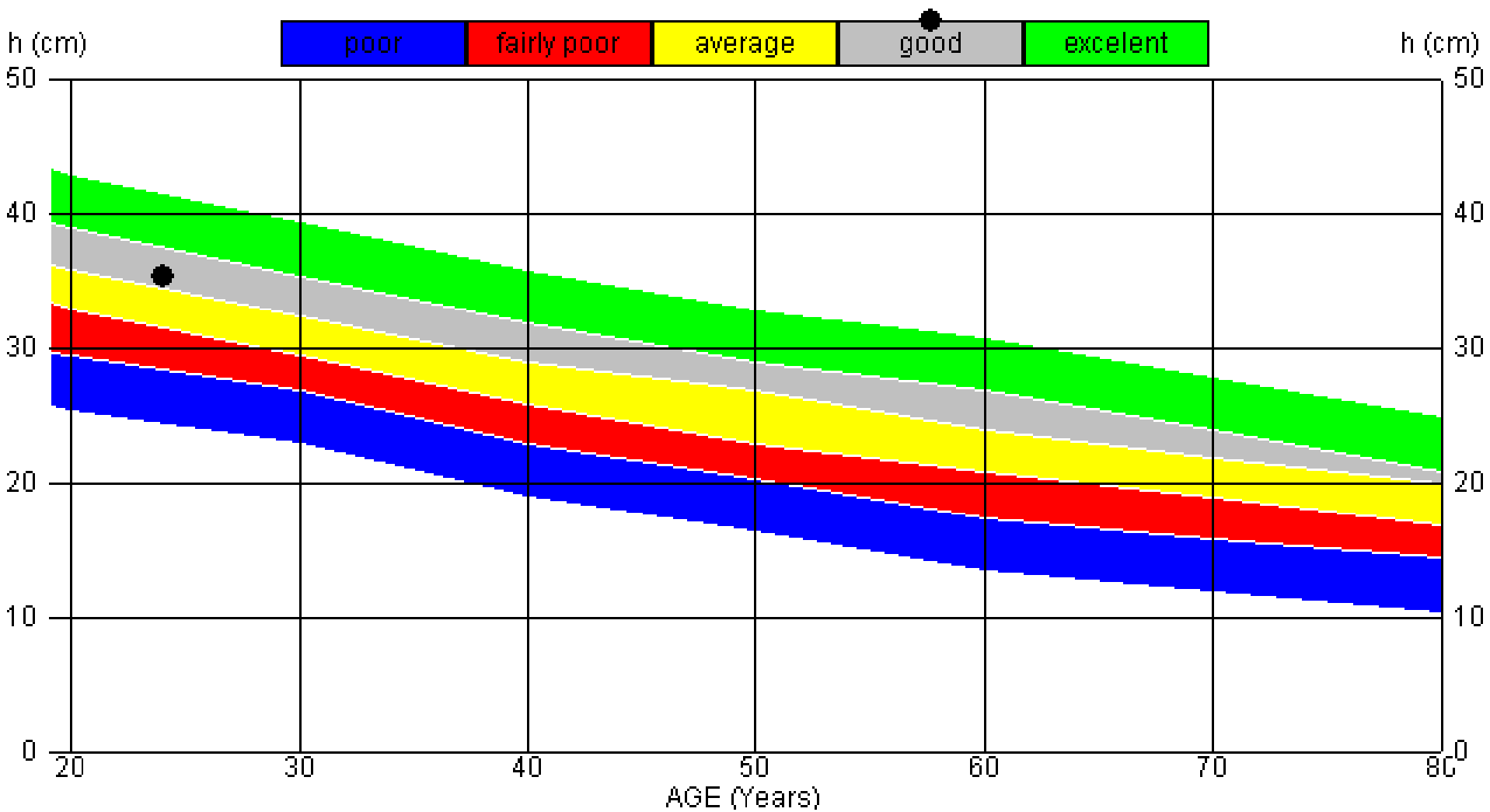
# BOYS



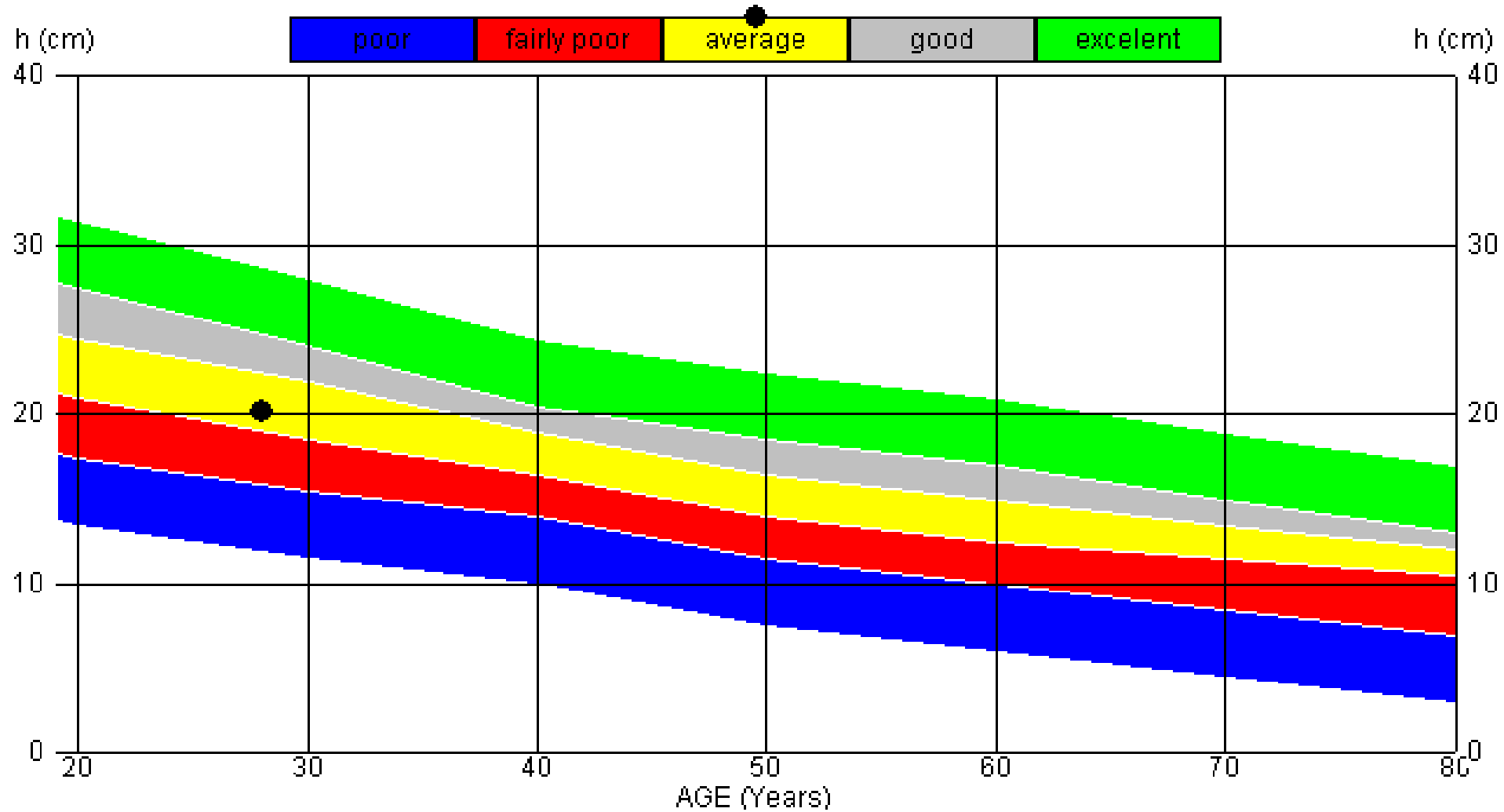
# GIRLS



# MALES



# FEMALES





INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

**Thank you for your attention.**

**Projekt: Zvyšování jazykových kompetencí pracovníků FSpS MU  
a inovace výuky v oblasti kinantropologie, reg. č.: CZ.1.07/2.2.00/15.0199**