STRESS TESTS

LABORATORY TESTS

FIELD TESTS

DIAGNOSTICS
abilities

AEROBIC

ANAEROBIC

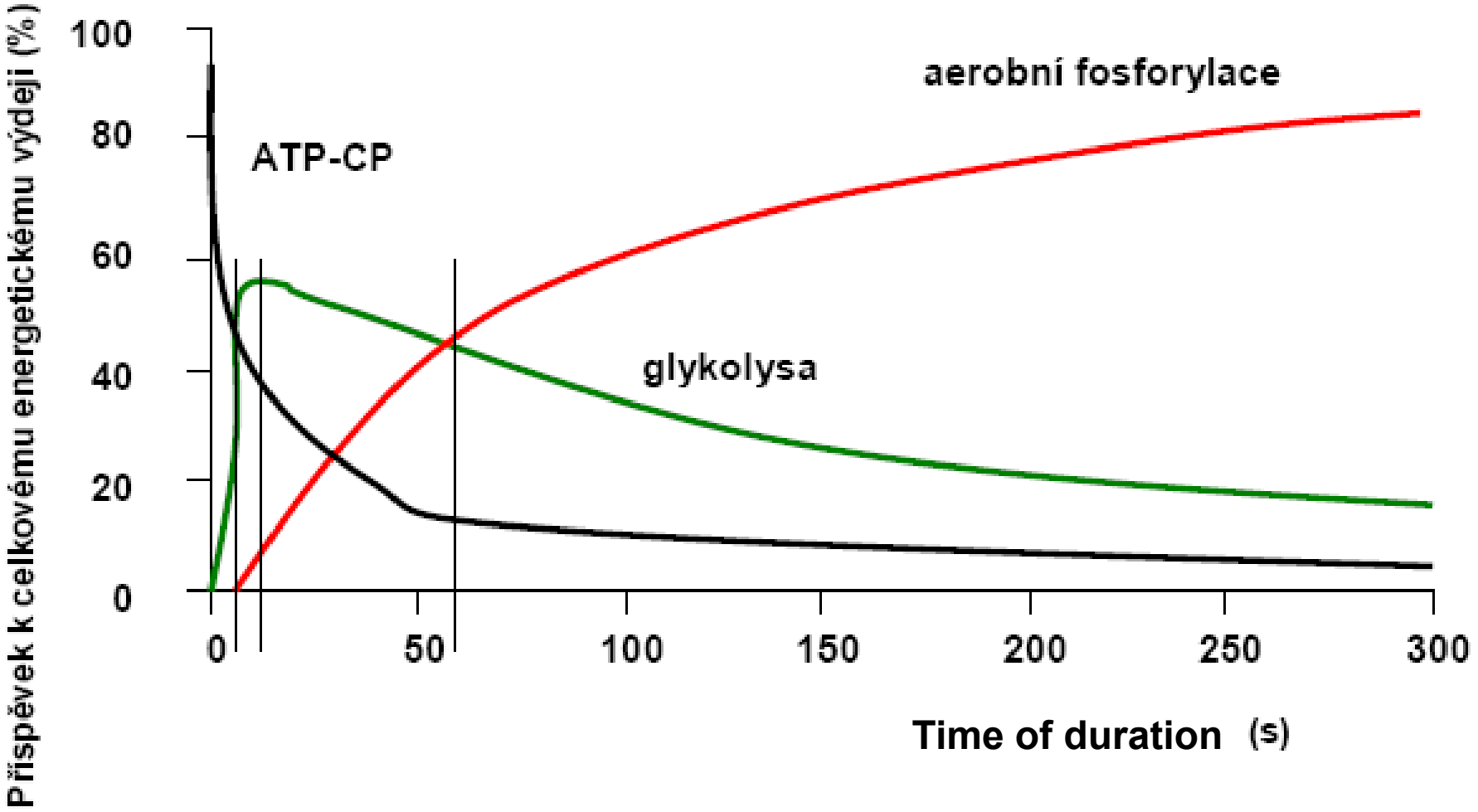
Anaerobic stress test

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).

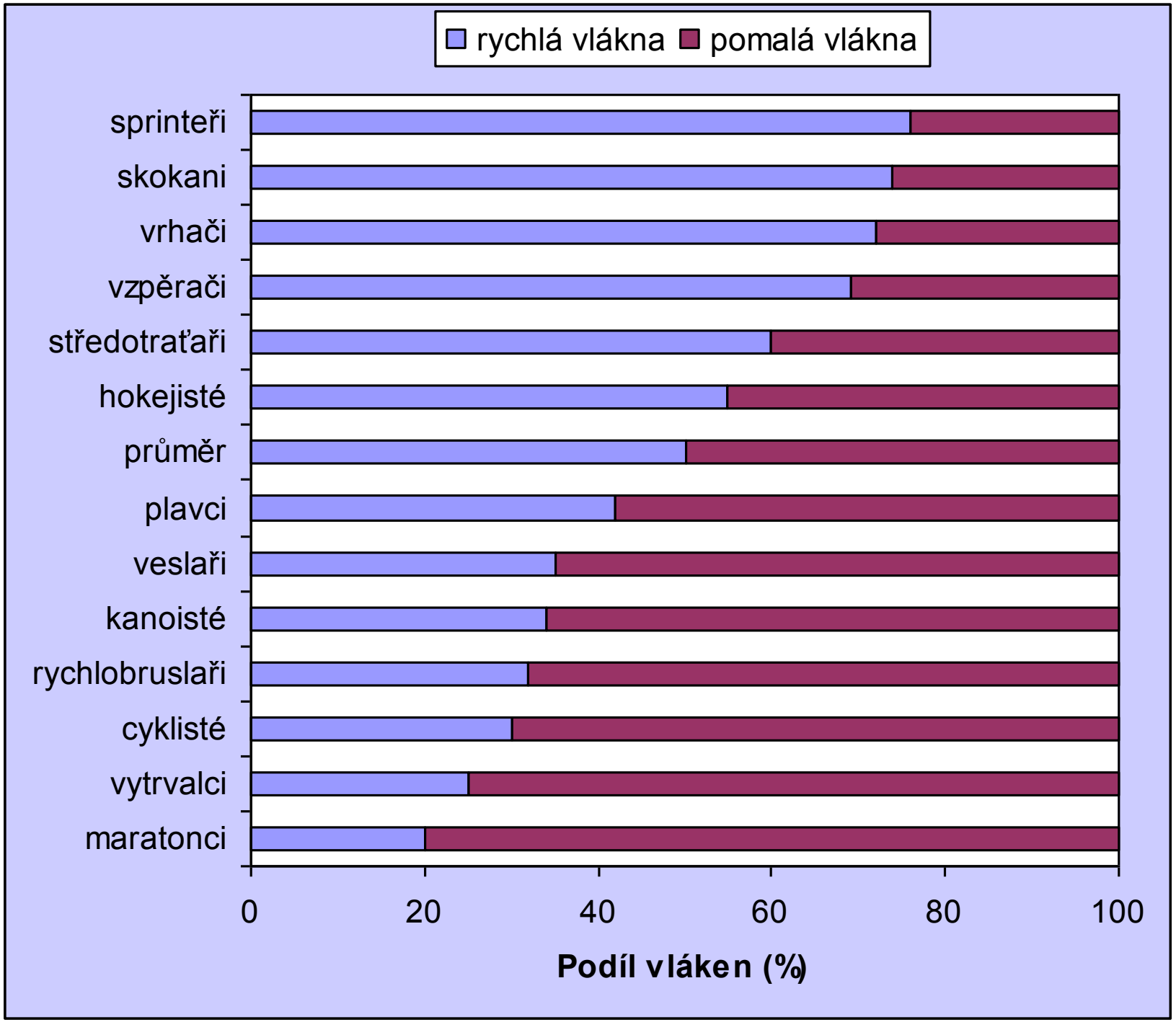


ANAEROBIC TESTS

- ***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 mitochodrií	**vysoká**	**vysoká**	**nízká**
Hustota kapilár	**vysoká**	**vysoká**	**nízká**
Aktivita ATP-ázy	**nízká**	**vysoká**	**vysoká**
Glykolytická kapacita	**nízká**	**vysoká**	**vysoká**


rychlá vlákna
pomalá vlákna
sprinteři
skokani
vrhači
vzpěrači
středotraťaři
hokejisté
průměr
plavci
veslaři
kanoisté
rychlobruslaři
cyklisté
vytrvalci
maratonci
0
20
40
60
80
100
Podíl vláken (%)

DIAGNOSTIKA svalových vláken

invazivní metoda – svalová biopsie

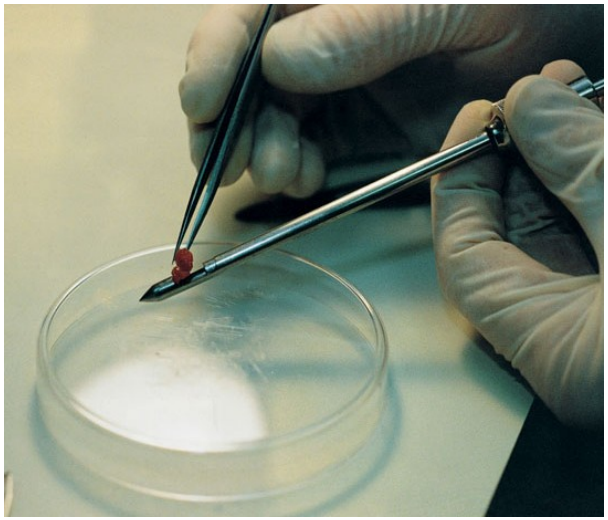
► magnetická rezonance se současnou analýzou biochemických parametrů snímaného svalu

► 1MR a následné cvičení s 80%
< 8 převaha II, 8-12 50%:50%, > 12 převaha I

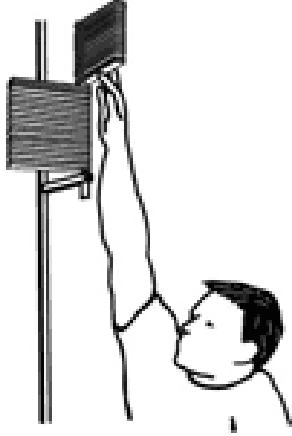
► výskoková ergometrie

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.

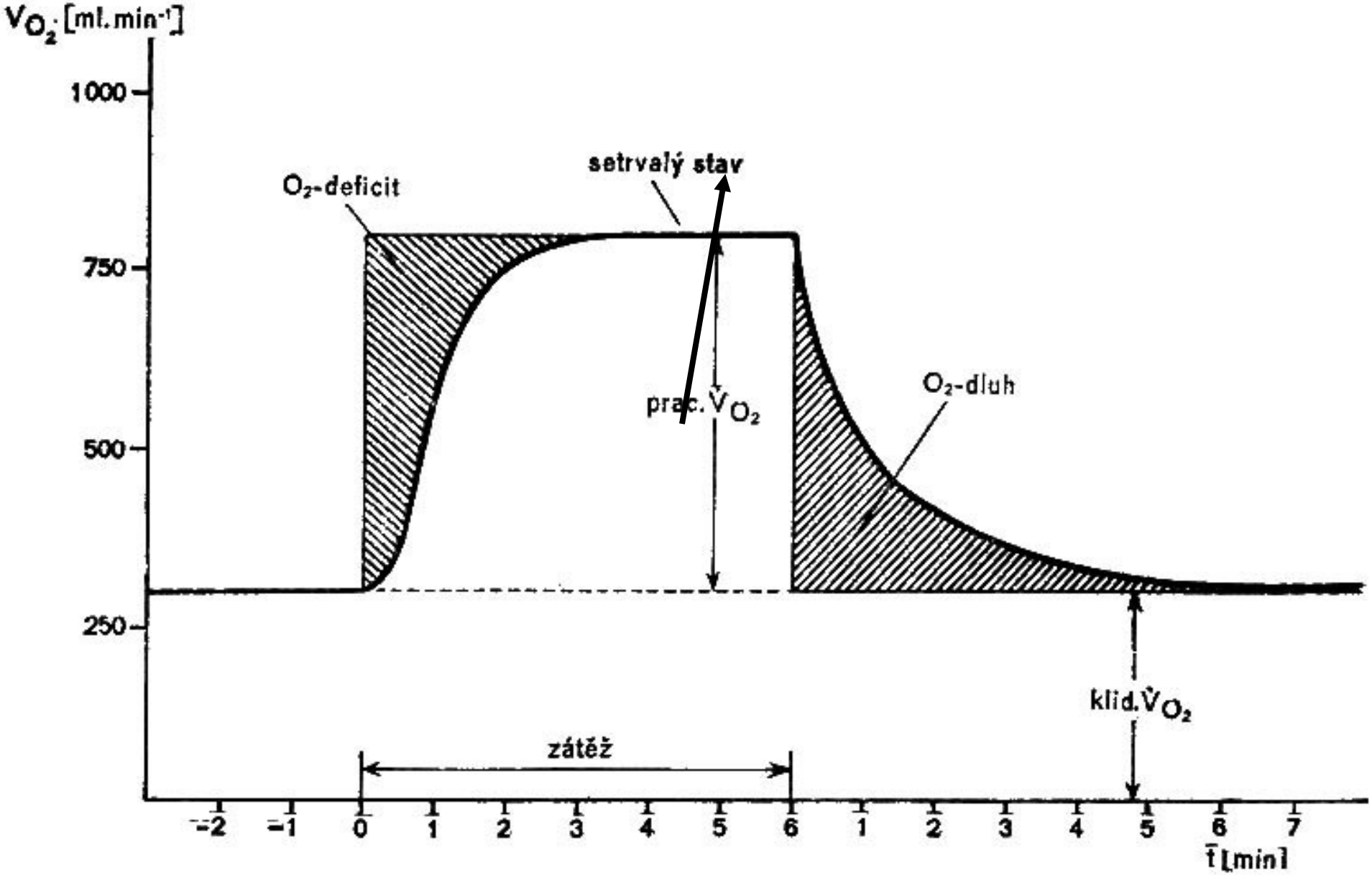


- Vertical Jump
- Step-running test (Margaria test)
- Test of anaerobic capacity – sprints on treadmill
- Isokinetic test
- EPOC/oxygen debt (oxygen deficit)
- Wingate test
- Výskoková ergometrie



- **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 [l]

- **Maximální kyslíkový dluh** (oxygen debt), maximální zotavovací kyslík je množství kyslíku, které převyšuje klidový příjem kyslíku (po skončení maximální zátěže do vyčerpání) [l]


V_{O_2} [ml.min^{-1}]
1000
750
500
250
O_2-deficit
setrvalý stav
prac. $\dot{V}O_2$
O_2-dluh
klid. $\dot{V}O_2$
zátěž
-2
-1
0
1
2
3
4
5
6
1
2
3
4
5
6
7
t [min]

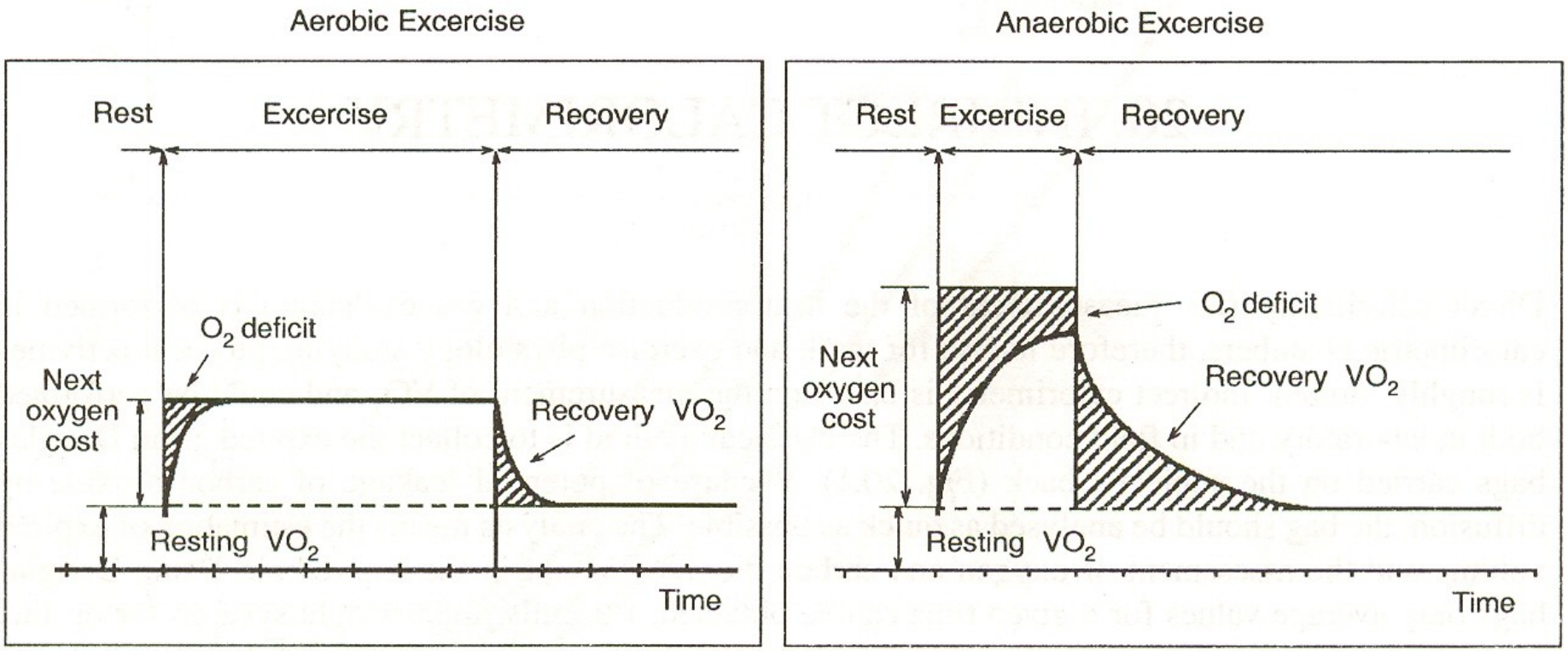


Fig. 20.2 Principle of indirect calorimetry, i.e. measurement of VO_2 at rest, during exercise and recovery.

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

Wingate test

(Wingate anaerobic test WAnT)

- is by far the most popular test of anaerobic perfomance
- the test involves pedalling for 30 seconds at supra-maximum effort, at a constant applied breaking 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.

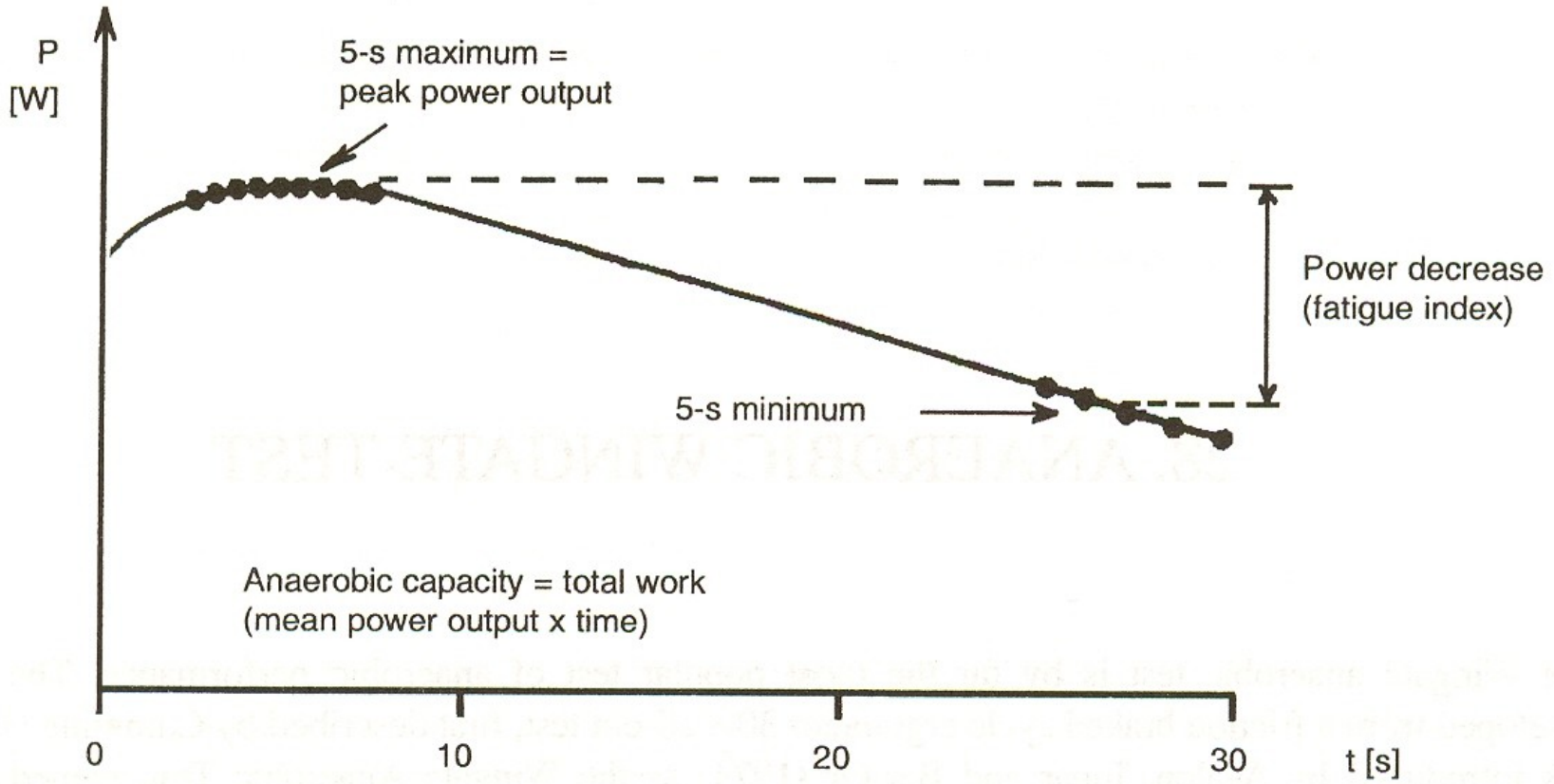


Fig. 28.1 Power output in the Wingate test and indices of the test.

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

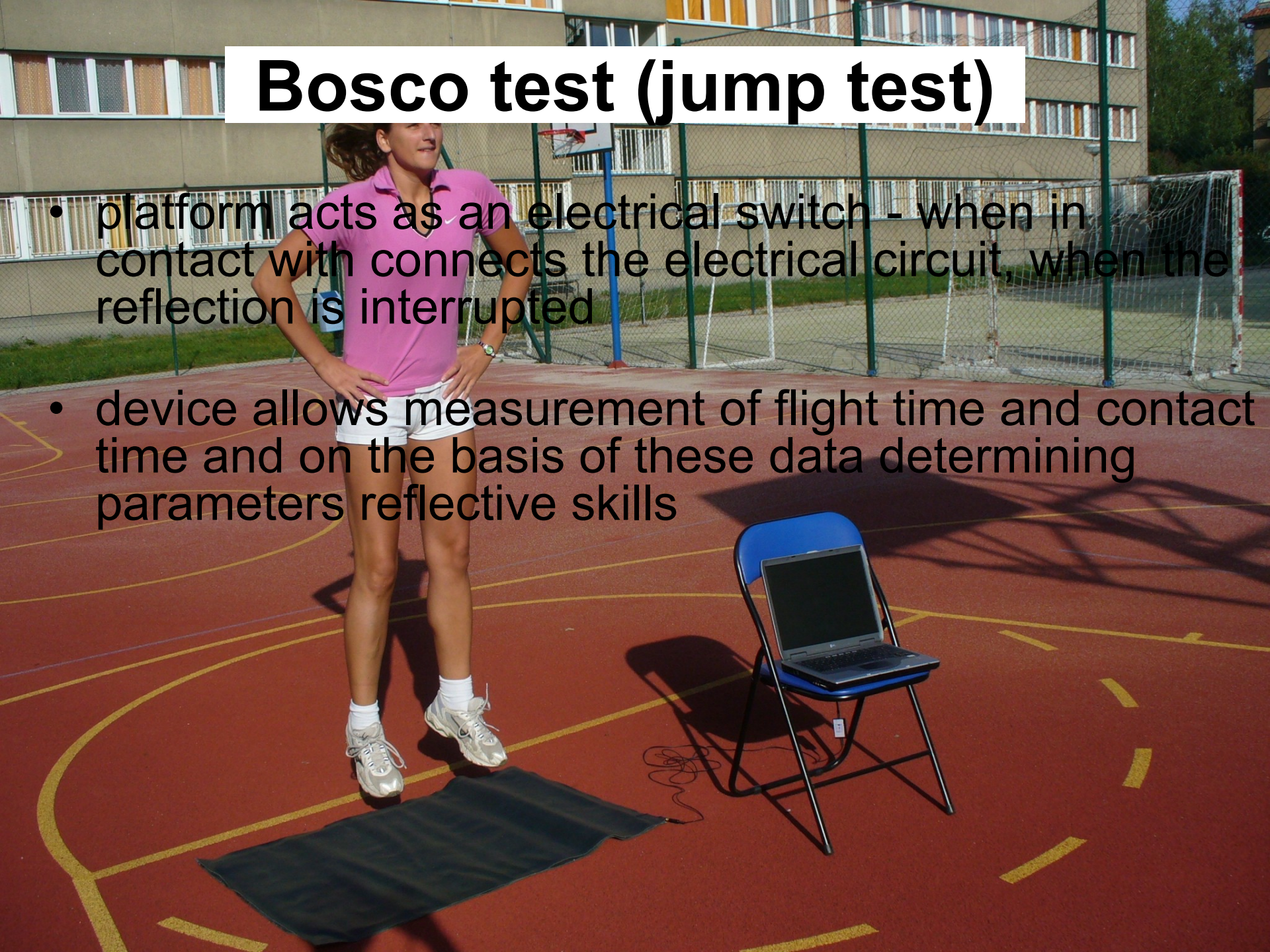
Wingate test – female athletes

	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 censecutive 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

tc (s) = contact time
tf (s) = flight time
P (W/kg) = power in the active phase of take off
P (W/kg) = average power
h = high jump
v (m/s)= speed
a (m/s^2)= acceleration
h/tc (cm/s) = high jump/contact time

	tc (s)	tf (s)	P (W/kg)	P (W/kg)	h (cm)	v (m/s)	a (m/s^2)	h/tc (cm/s)
1								
2								
3								

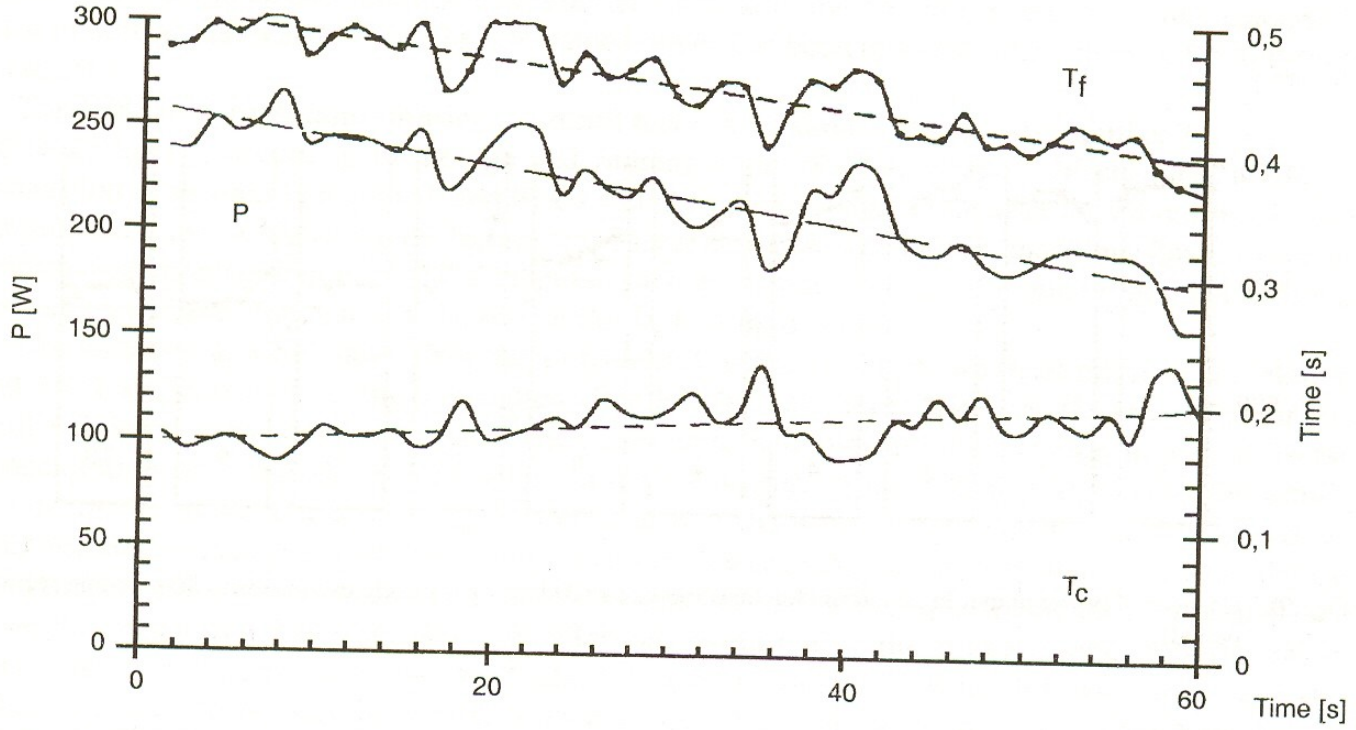
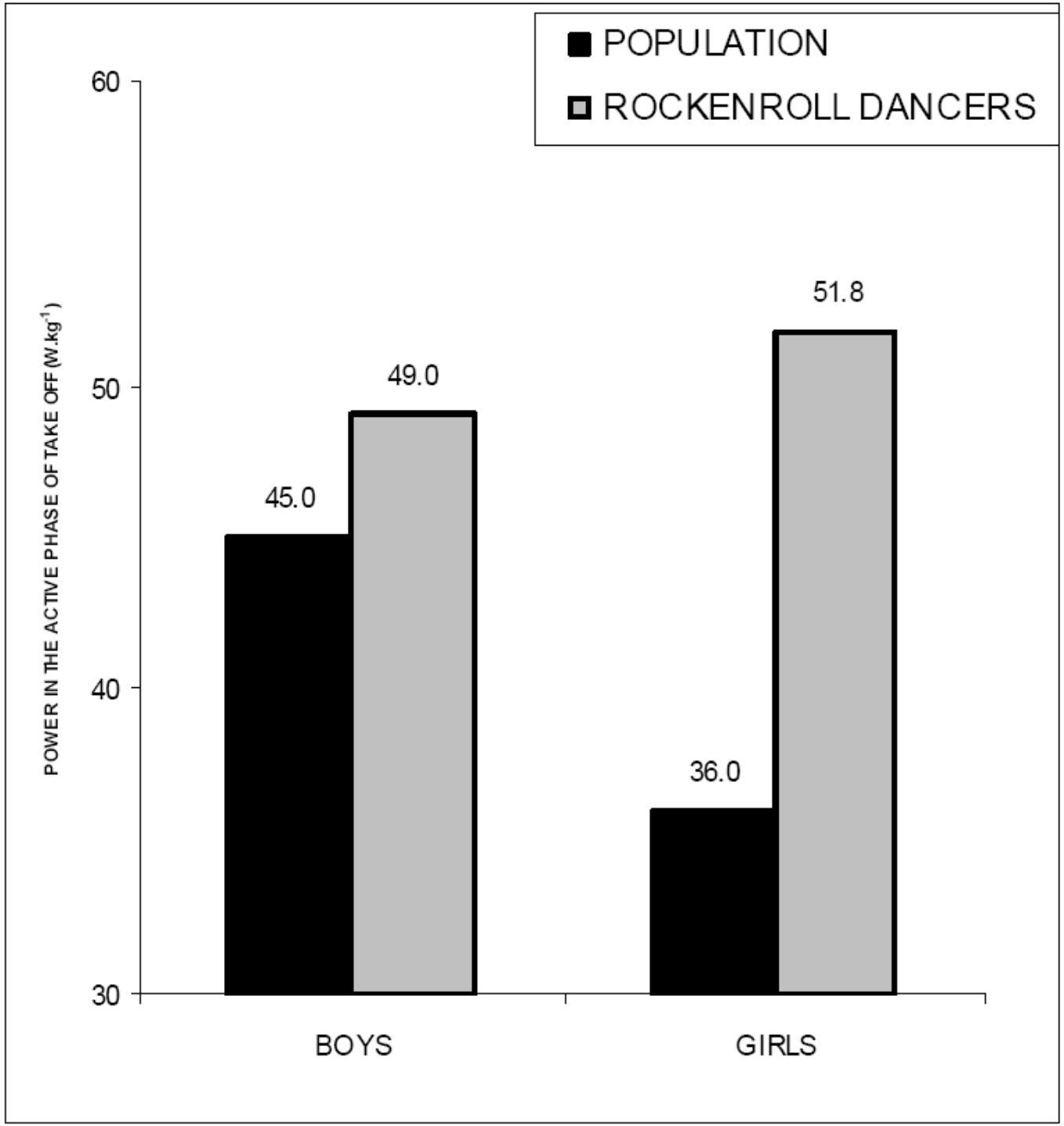
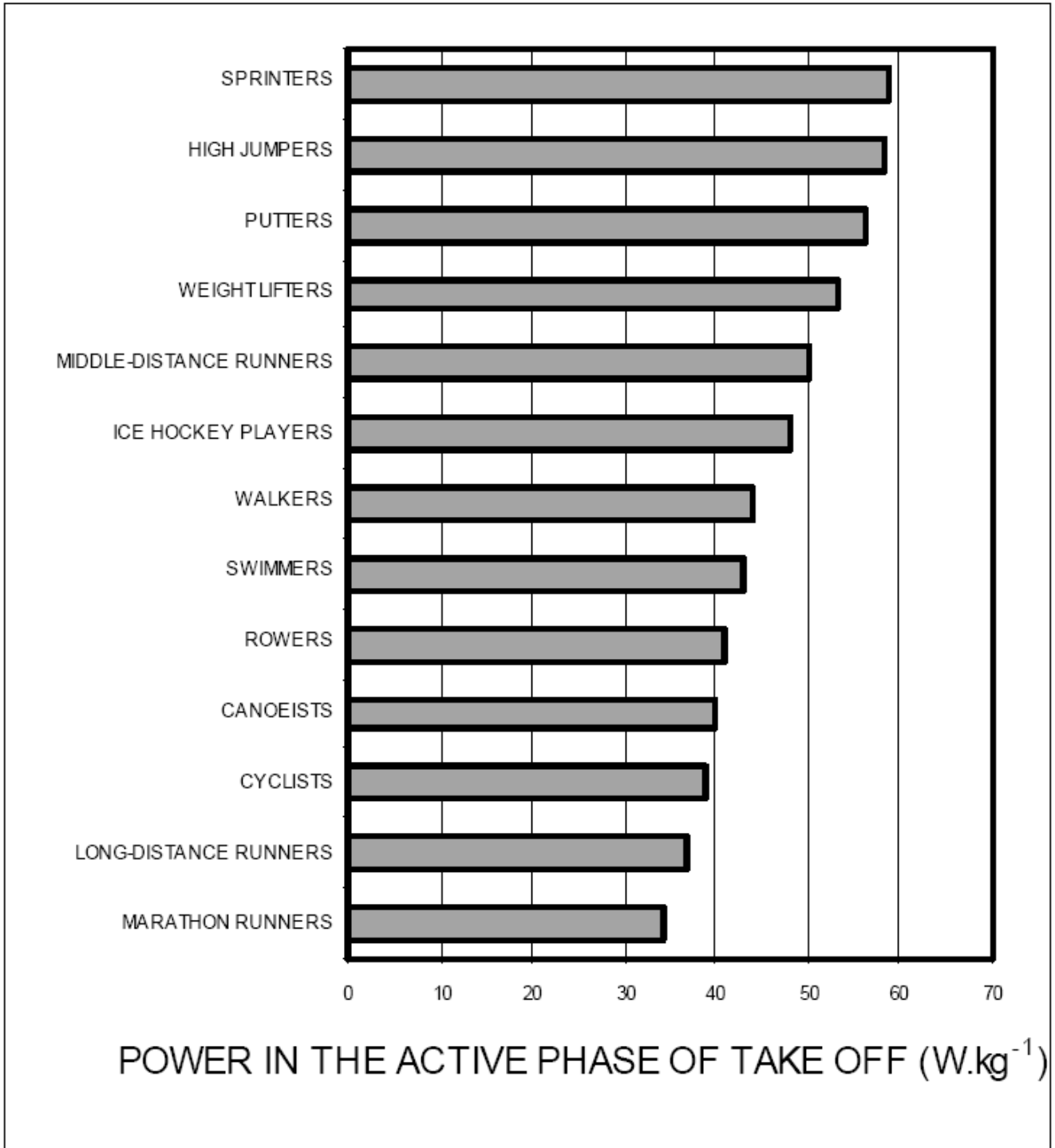


Fig. 30.2 Example of a 60-s Bosco test. Flight time (T_f) and power output (P) decrease and contact time (T_c) inversely increases throughout the 60-s test.

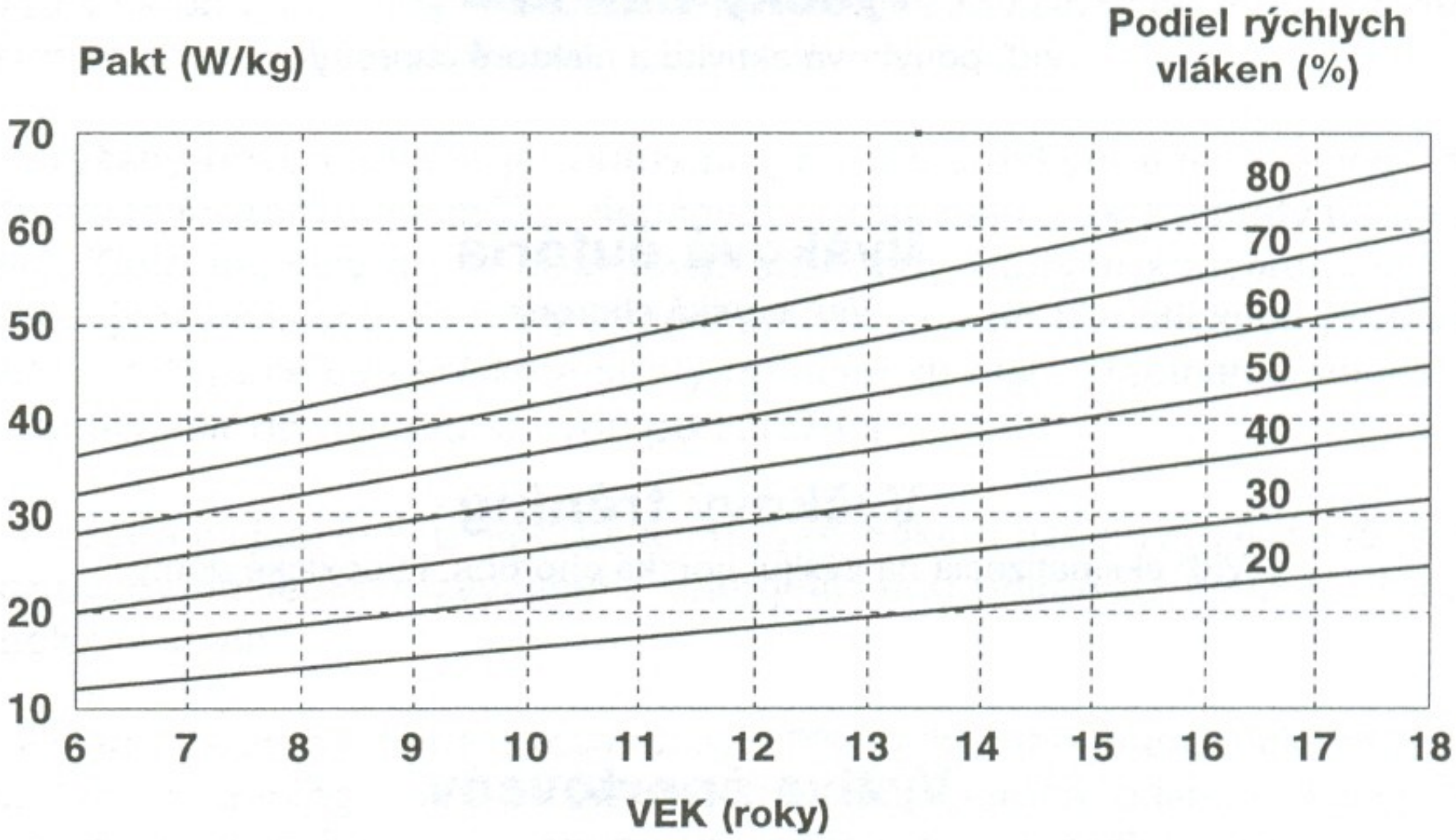
Table 30.2 Typical values of flight time (T_f), contact time (T_c), average power (P) and blood lactate (LA) in the 60-s Bosco test (Heller et al., unpublished data).

	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

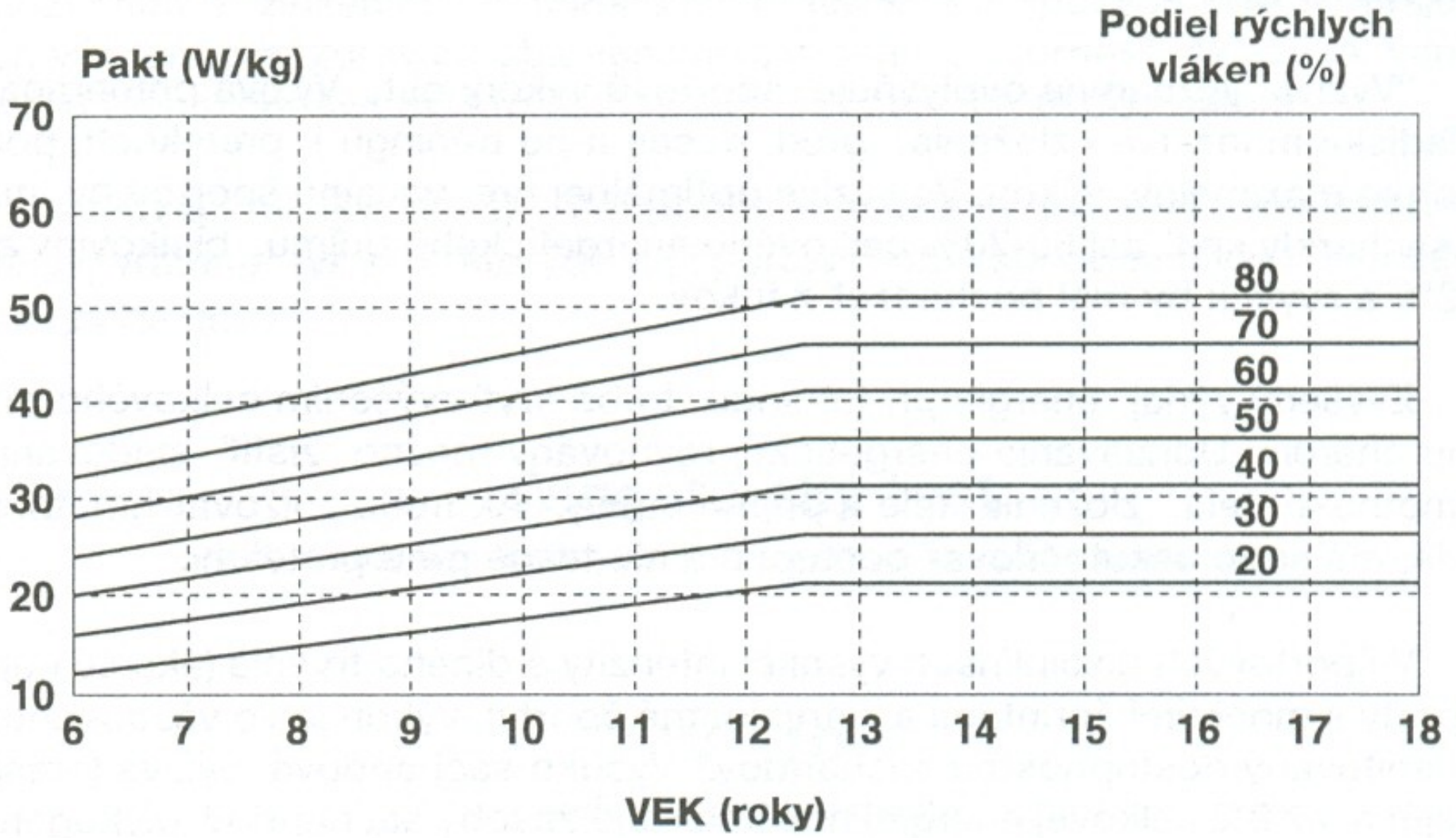

POPULATION
ROCKENROLL DANCERS
POWER IN THE ACTIVE PHASE OF TAKE OFF (W.kg-1)
60
50
40
30
45.0
49.0
36.0
51.8
BOYS
GIRLS


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)

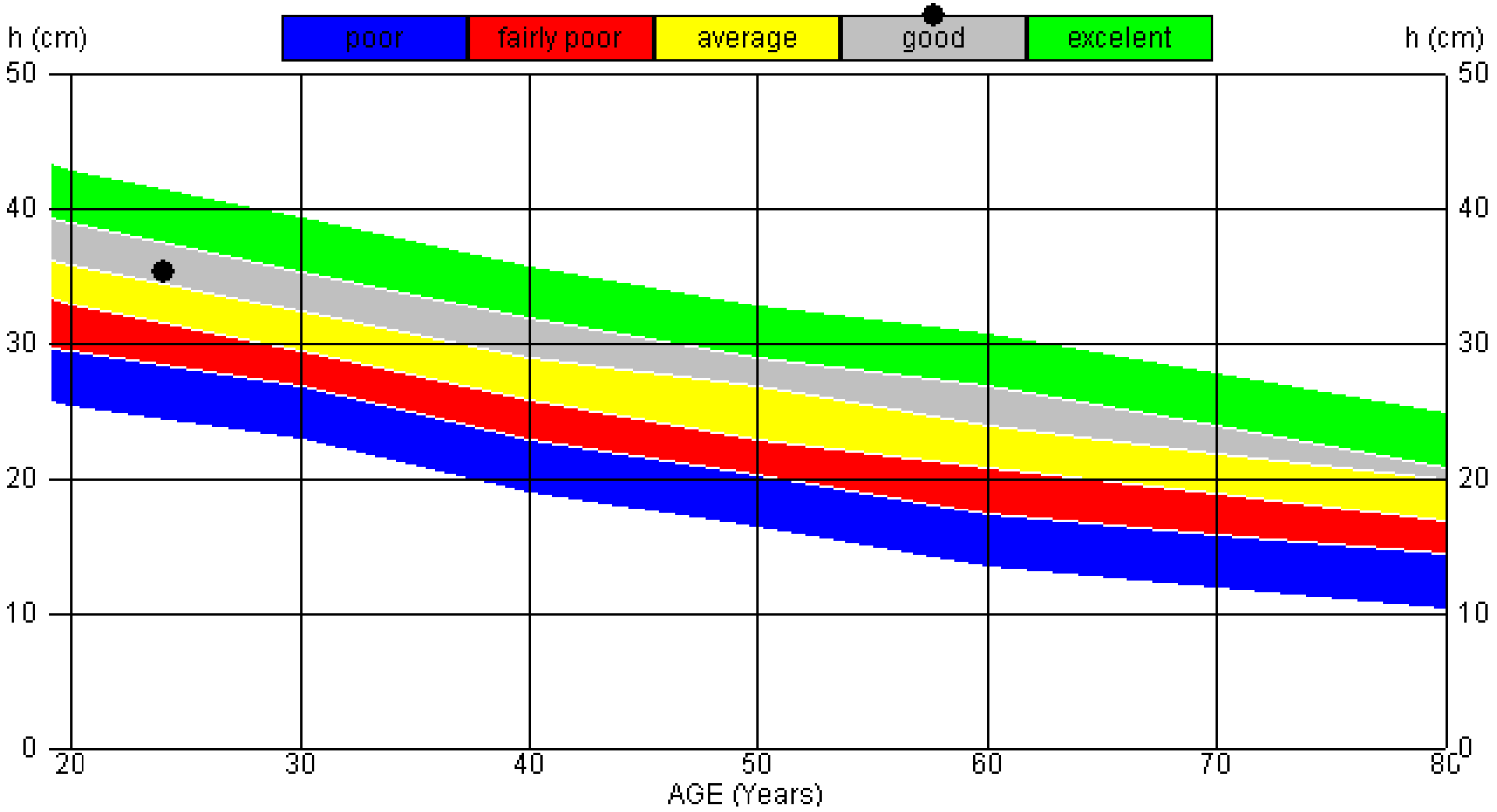
BOYS


Pakt (W/kg)
Podiel rýchlych vláken (%)
70
60
50
40
30
20
10
6
7
8
9
10
11
12
13
14
15
16
17
18
VEK (roky)
80
70
60
50
40
30
20

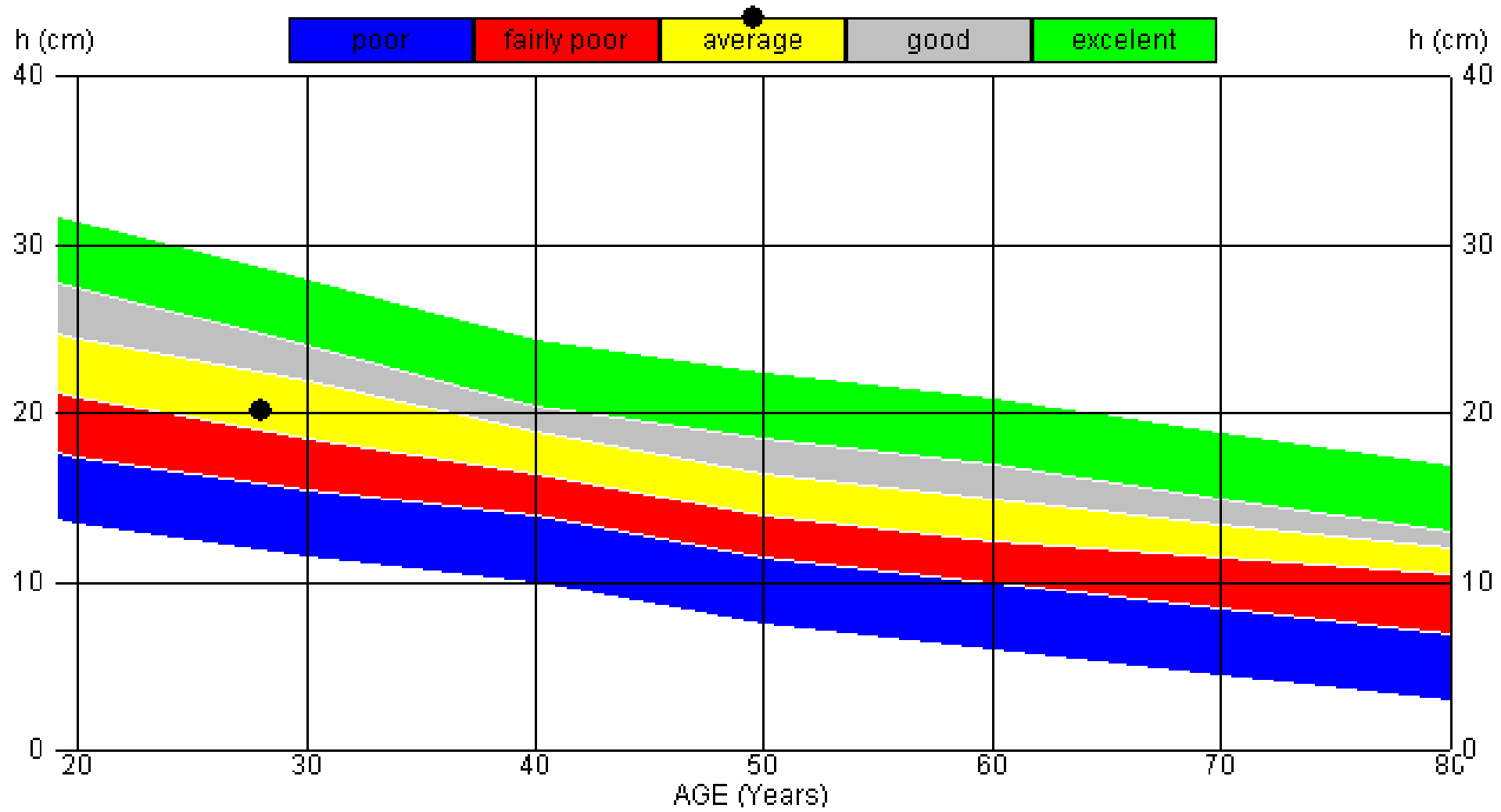
GIRLS


Pakt (W/kg)
Podiel rýchlych vláken (%)
70
60
50
40
30
20
10
80
70
60
50
40
30
20
6
7
8
9
10
11
12
13
14
15
16
17
18
VEK (roky)

MALES


poor
fairly poor
average
good
excelent
h (cm)
h (cm)
50
40
30
20
10
0
20
30
40
50
60
70
80
AGE (Years)

FEMALES


poor
fairly poor
average
good
excelent
h (cm)
h (cm)
40
30
20
10
0
20
30
40
50
60
70
80
AGE (Years)