

# Monitoraggio della fitness

martedì 3 e martedì 31 Maggio 2005

Fitness = benessere psico-fisico

ma anche performance (prestazione)

- 1)  $v_{Max}$ ;
- 2)  $F_{Max}$ ;
- 3) endurance;
- 4) economia

## Situazioni

a) evento agonistico -> risultato;

b) allenamento -> valutazione funzionale  
(laboratorio o campo)

## Situazioni (2)

- 1) esercizio ad alta intensita'  
& breve durata (sprint);
- 2) esercizio a media-bassa intensita'  
& media-lunga durata (resistenza)

## Alta intensita'/Breve durata

- input metabolico ('benzina consumata') puo' aumentare in una frazione di secondo di piu' di 50 volte (da ca 1 a 50  $W \cdot kg^{-1}$ ,  $2.86 \div 143 \text{ mlO}_2 \cdot kg^{-1} \cdot \text{min}^{-1}$ )!

<i>Fonti energetiche</i>	<i>Potenza max (<math>W \cdot kg^{-1}</math>)</i>	<i>Capacità max (<math>kJ \cdot kg^{-1}</math>)</i>	<i>Tempo di esaurimento alla potenza max</i>	
Anaerobiche alattacide	72	0,85	~ 6 s	Sprinter
(idrolisi PC)	52	0,75		Fondista
	56	0,75		Non atleta
Anaerobiche lattacide	26	1,0	~ 40 s	Non atleta
Ossidative	19	da 4000 a 8000	~ 25 min	Sprinter
	26			Fondista
	16			Non atleta

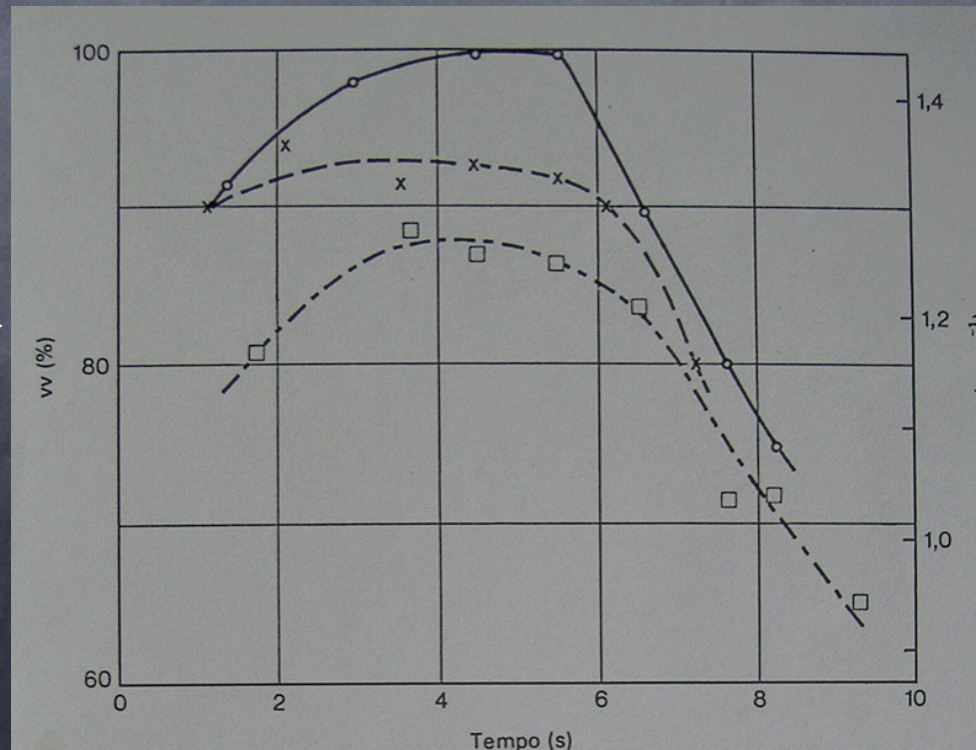
- 'motore' solo muscoli attivi (30% m, 20 kg su 70);
- 'motore' aumenta consumo di  $50 / .3 \approx 167x$ ;
- $\dot{W}$  durante salto a piedi paralleli ca 4 volte 5" corsa  $v_{Max}$ ;
- 'motore' aumenta consumo  $\approx 670x!!$

di Prampero, edi-ermes 1985

## Alta intensita' / Breve durata (2)

- PC  $\rightarrow$  ATP;
- $\dot{W} = \eta \dot{A}l$ ;
- $\dot{W}_{Max} = \eta \dot{A}l_{Max}$ ;
- Test di Margaria (Margaria et al., JAP 1966): salire scala 2-3 gradini alla volta  $v_{Max}$  corsa, misura  $v_{vi}$ ;

$r$   
 $+18 \text{ ml O}_2 \text{ kg}^{-1} \text{ min}^{-1}$   
 $+35 \text{ ml O}_2 \text{ kg}^{-1} \text{ min}^{-1}$   
 $v_{vMax} = 1.45 \text{ ms}^{-1}$   
 $W_{Max} = 1.45 \text{ kg}_p \text{ m kg}^{-1}$   
 $\dot{W}_{Max} = 1.45 \text{ kg}_p \text{ m kg}^{-1} \text{ s}^{-1}$   
 $= 14.21 \text{ W kg}^{-1}$   
 $\eta = 25\%$   
 $\dot{A}l_{Max} = \dot{W}_{Max} / \eta$   
 $= 56.84 \text{ W kg}^{-1}$



## Alta intensita' / Breve durata (3)

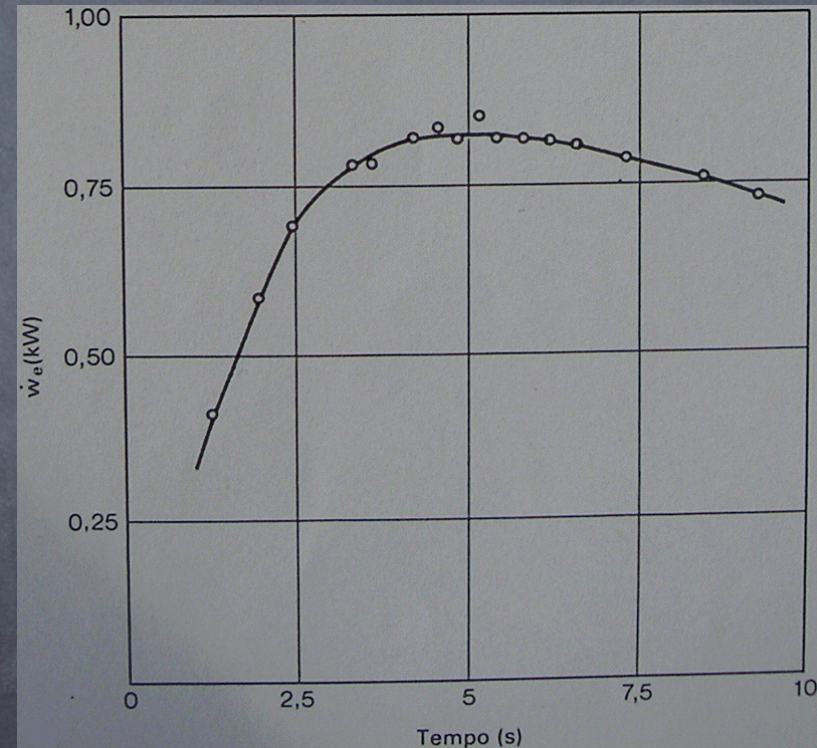
- Test di Ikuta ed Ikai (Ikuta et al., Res Phys Ed 1972):  
pedalare al cicloergometro a  $\dot{W}_{Max}$  e misura di  $\dot{W}_i$ ;

$\dot{W}_{Max} \approx .8 \text{ kW}$   
 $= 11.42 \text{ W kg}^{-1}$   
 $\approx 1/5 \dot{W}_{Max} \text{ Margaria}$

alta  $v$

->  $\eta$  minore

->  $\dot{A}_{I_{Max}}$  Ikuta & Ikai  $\approx \dot{A}_{I_{Max}}$  Margaria



## Alta intensita' / Breve durata (4)

- (salto a piedi paralleli)  $\dot{W}$  media ca 2 volte 5" corsa  $v_{Max}$  e  $\dot{W}$  picco ca 4 volte;

$\dot{W}_{Max}$  media  $\approx 15 \times 2 \text{ W kg}^{-1} = 30 \text{ W kg}^{-1}$

$\dot{W}_{Max}$  picco  $\approx 15 \times 4 \text{ W kg}^{-1} = 60 \text{ W kg}^{-1}$

(70 kg, 4.2 kW=5.7 CV)

(871 kg, 51 kW=69 CV)

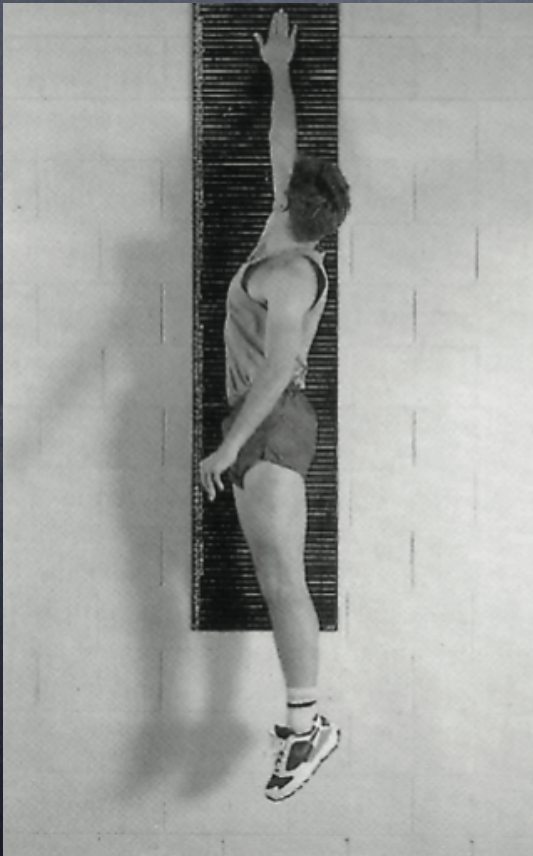
$\dot{W}_{Max}$  picco =  $51,000/871 \text{ W kg}^{-1} = 59 \text{ W kg}^{-1}$





## Variazioni sul tema

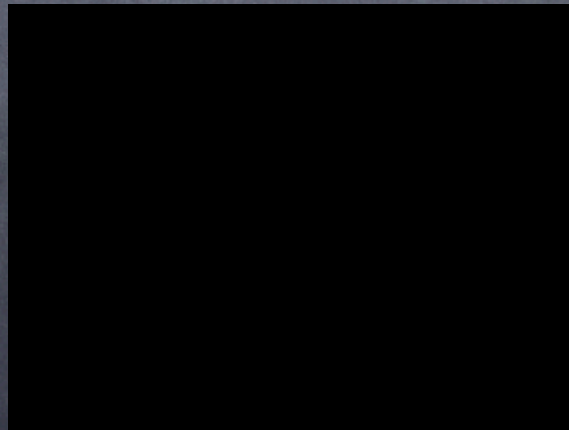
- test Margaria-Kalamen: no bisogno misura  $v_i$ , 16 gradini (3 alla volta) con misura  $t$  (.01") solo tra g3 & g9;
- test di Sargent (Sargent, Am Phys Ed Rew 1921): salto, problema standardizzazione;



- test Sargent-Lewis: durata salto 1"

## Alta intensita' / Breve durata (bis)

- PC & glicogeno-lattato → ATP;
- Test di Wingate: pedalare free-wheeling a  $v_{MAX}$ , carico improvviso, conta rivoluzioni 0÷5" → PC e 0÷30" → glicogeno-lattato  
(<http://www.brianmac.demon.co.uk/want.htm>  
<http://www.brianmac.demon.co.uk/excel/wingate.xls>)

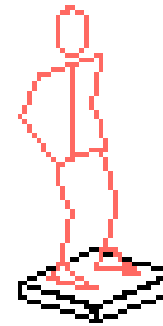
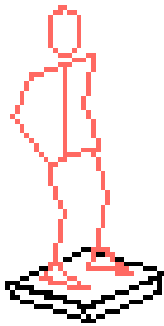


# Alta intensita'/Breve durata (bis2)

- test(s) di Bosco (Bosco et al., EJAPOP 50 1983, ...):

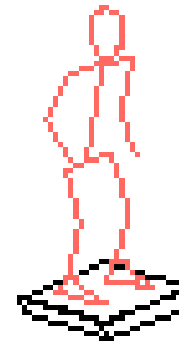
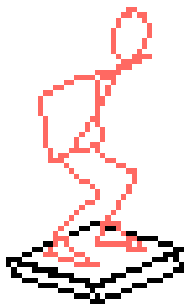
a) squat jump (PC);

b) counter movement jump (+elastico);



c) continuous jump with bent legs  
(+glicogeno-lattato);

d) continuous jump  
with straight legs



- moto di un grave:

$$v_v = v_i - gt$$

$$0 = v_{Max} - gt$$

$$t = v_{Max}/g$$

$$t = 2v_{Max}/g$$

$$v_{Max} = gt/2$$

# Media-bassa intensita' / Media-lunga durata

- carboidrati & lipidi → ATP;
- (glicogeno-lattato) ← lattacidemia;
- $\dot{V}O_2$  (soglia e  $\dot{V}O_{2Max}$ , capacita' aerobica, protocolli x  $\dot{V}O_{2Max}$  e soglia);
- economia (protocolli x economia)



**Table 15.5 Treadmill Protocols**

**A—Protocol for Poorly Fit Subjects (60)**

Stage*	METs	Speed (mph)	% Grade
1	2.5	2	0
2	3.5	2	3.5
3	4.5	2	7.0
4	5.5	2	10.5
5	6.5	2	14.0
6	7.5	2	17.5
7	8.5	3	12.5
8	9.5	3	15.0
9	10.5	3	17.5

\*Stage lasts three minutes

**B—Protocol for Normal, Sedentary Subjects (11)**

Stage*	METs	Speed (mph)	% Grade
1	4.3	3	2.5
2	5.4	3	5.0
3	6.4	3	7.5
4	7.4	3	10.0
5	8.5	3	12.5
6	9.5	3	15.0
7	10.5	3	17.5
8	11.6	3	20.0
9	12.6	3	22.5

\*Stage lasts two minutes

**C—Protocol for Young, Active Subjects (15)**

Stage*	METs	Speed (mph)	% Grade
1	5	1.7	10
2	7	2.5	12
3	9.5	3.4	14
4	13	4.2	16
5	16	5.0	18

\*Stage lasts three minutes

**D—Protocol for Very Fit Subjects (7)**

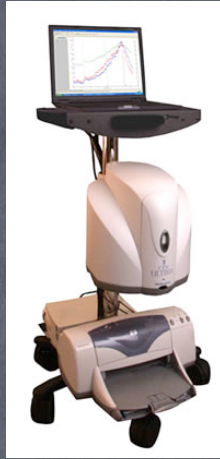
Stage*	METs	Speed (mph)	% Grade
1	12.9/18	7/10	2.5
2	14.1/19.8	7/10	5.0
3	15.3/21.5	7/10	7.5
4	16.5/23.2	7/10	10.0
5	17.7/24.9	7/10	12.5

\*Stage lasts two minutes; vigorous warm-up precedes test.

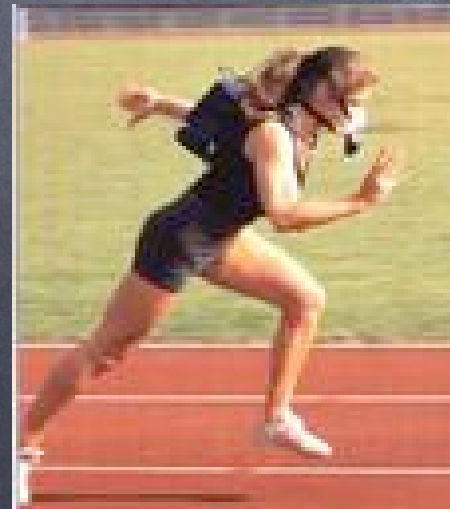
60 National Exercise Heart Disease  
 11 Standard Balke  
 15 Bruce  
 7 Åstrand

# Metabografi

- laboratorio;



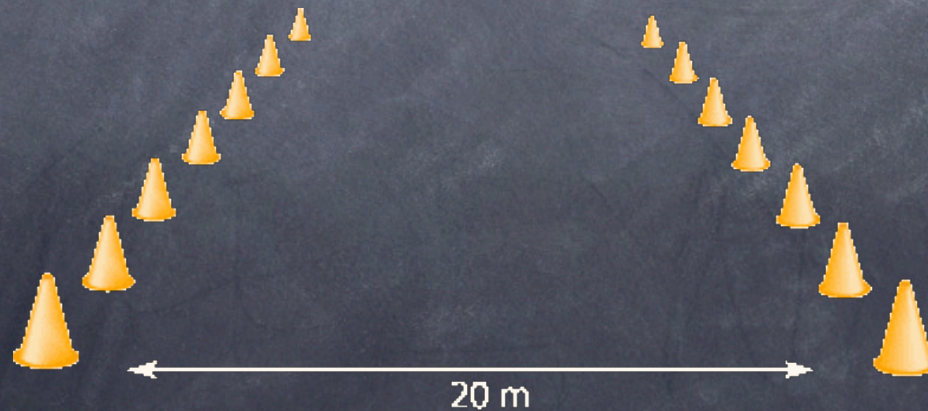
- campo;



## Variazioni sul tema

- test di Cooper (Cooper, JAMA 1968): correre il piu' possibile in 12',  $\dot{V}_{O_{2Max}} = (\text{dist. [m]} - 505) / 45$ ;

- test di Leger (Leger et al., EJAPOP 1982): 'navetta' 20 m,  $\dot{V}_{O_{2Max}} = 5.857v_{Max} - 19.458$ ;

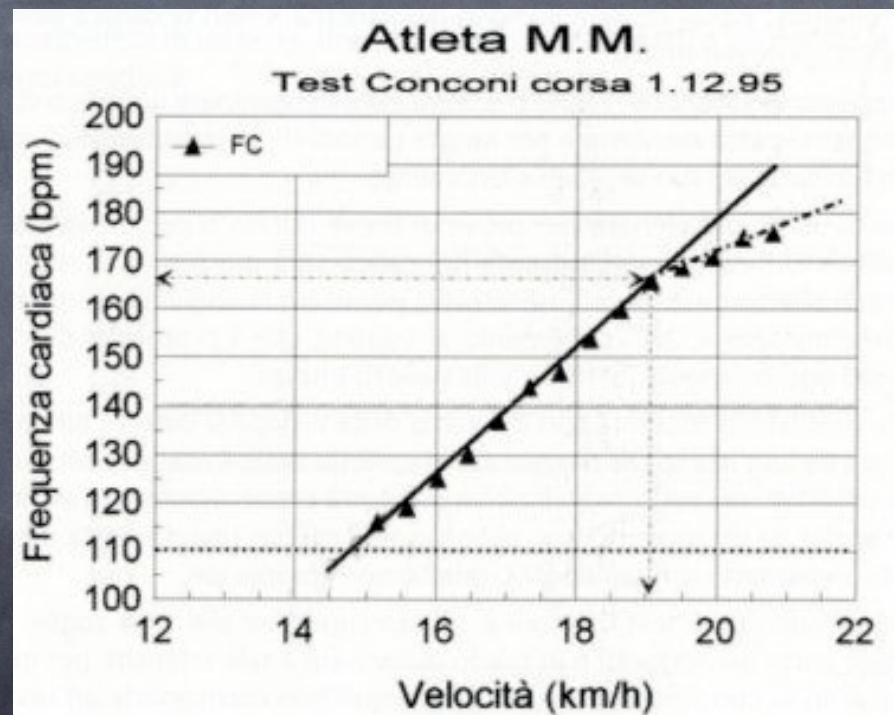




Stage Met	$\dot{V}O_2$ max (ml · kg · min <sup>-1</sup> )	Time (min)	Speed (km · h <sup>-1</sup> )	Split time (s/20 m)
7	24.5	2	7.51 <i>2.09</i>	9.693
9	31.5	4	8.70 <i>2.42</i>	8.276
10	35.0	6	9.30 <i>2.58</i>	7.744
11	38.5	8	9.90 <i>2.75</i>	7.276
12	42.0	10	10.49 <i>2.91</i>	6.862
13	45.5	12	11.09 <i>3.08</i>	6.492
14	49.0	14	11.69 <i>3.25</i>	6.160
15	52.5	16	12.29 <i>3.41</i>	5.860
16	56.0	18	12.88 <i>3.58</i>	5.589
17	59.5	20	13.48 <i>3.74</i>	5.341
18	63.0	22	14.08 <i>3.91</i>	5.114
19	66.5	24	14.68 <i>4.08</i>	4.906
20	70.0	26	15.27 <i>4.24</i>	4.714
21	73.5	28	15.87 <i>4.41</i>	4.537
22	77.0	30	16.47 <i>4.58</i>	4.372
23	80.5	32	17.07 <i>4.74</i>	4.219

# Soglia

- test di Conconi (Conconi et al., 1982): pista/treadmill/cicloergometro



## Raccomandazioni test Conconi

- 1) non piu' di 10 bpm di  $\Delta HR_{step}^{-1}$ ;
- 2)  $+0.5 \text{ kmh}^{-1} (200 \text{ m})^{-1}$ ;
- 3) 10÷12'

# Economia

- $\dot{V}_{O_2} \rightarrow C$  [ml O<sub>2</sub> kg<sup>-1</sup>m<sup>-1</sup>] =  $\dot{V}_{O_{2n}}$  [ml O<sub>2</sub> kg<sup>-1</sup>s<sup>-1</sup>] / v [ms<sup>-1</sup>] (=1/economia);
- $v = \dot{V}_{O_{2n}} / C$ ;
- $v_{Max} = f \dot{V}_{O_{2nMax}} / C$ ;

	C	v <sub>Max</sub>
nuoto	15 J kg <sup>-1</sup> m <sup>-1</sup> (1 J = 20.9 ml O <sub>2</sub> )	1.9 ms <sup>-1</sup>
corsa	4	7.9
marcia	2	5.6
sci di fondo	2	7.6
pattinaggio su ghiaccio	1	13.6
ciclismo	.5	13.9