Laurea specialistica in Scienze e tecniche dello sport

Biomeccanica del movimento e dello sport ARDIGO' 20 (2010/2011)

La locomozione e le 'interferenze' ambientali

Giovedì 31 Marzo h. 13:30÷15 Biomeccanica del movimento e dello sport ARDIGO' 20

Luca P. Ardigò

Mezzo

(aria)

(pista, l. m.)

Resistenza aerodinamica in pista

$d\dot{V}_{O2} = aFS$

$F = bV^2$

$d\dot{V}_{O2} = abSV^2$ (eq. 4)

$(d\dot{V}_{O2} =)\ abSV^2 = .0089V^{2*} = .002V^{3*}$

(aria calma)

$ab = .0089/4.42 = .00201^*$

$d\dot{V}_{O2} = (A_p/.478).002V^3 = .00418A_pV^3$

$d\dot{V}_{O2} = .436 \times .00418(6.0)^3 = .394$ l/min -> 6.4 ml/kg min (≈6.3)

(61.3 kg)

The Mosteller[1] formula

BSA (m^2) = ([Height(cm) x Weight(kg)]/ 3600)$^{1/2}$ e.g. BSA = SQRT((cm*kg)/3600)

or in inches and pounds: BSA (m^2) = ([Height(in) x Weight(lbs)]/ 3131)$^{1/2}$

The DuBois and DuBois[2] formula

BSA (m^2) = 0.20247 x Height(m)$^{0.725}$ x Weight(kg)$^{0.425}$

A variation of DuBois and DuBois[15] thats gives virtually identical results is:

BSA (m^2) = 0.007184 x Height(cm)$^{0.725}$ x Weight(kg)$^{0.425}$

The Haycock[3] formula

BSA (m^2) = 0.024265 x Height(cm)$^{0.3964}$ x Weight(kg)$^{0.5378}$

The Gehan and George[4] formula

BSA (m^2) = 0.0235 x Height(cm)$^{0.42246}$ x Weight(kg)$^{0.51456}$

The Boyd formula[5]

BSA (m^2) = 0.0003207 x Height(cm)$^{0.3}$ x Weight(grams)$^{(0.7285 - (0.0188 \times LOG(grams))}$

Mezzo
(aria)

corsa

$\dot{V}_{O2}$ vs. velocità

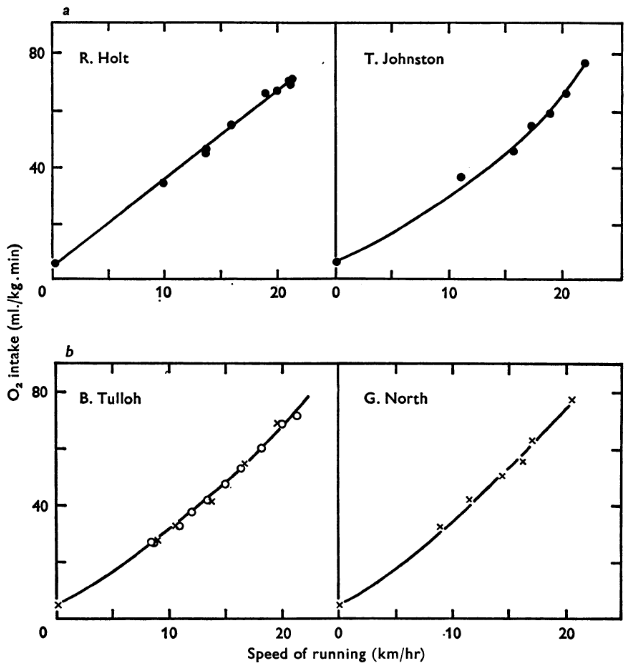
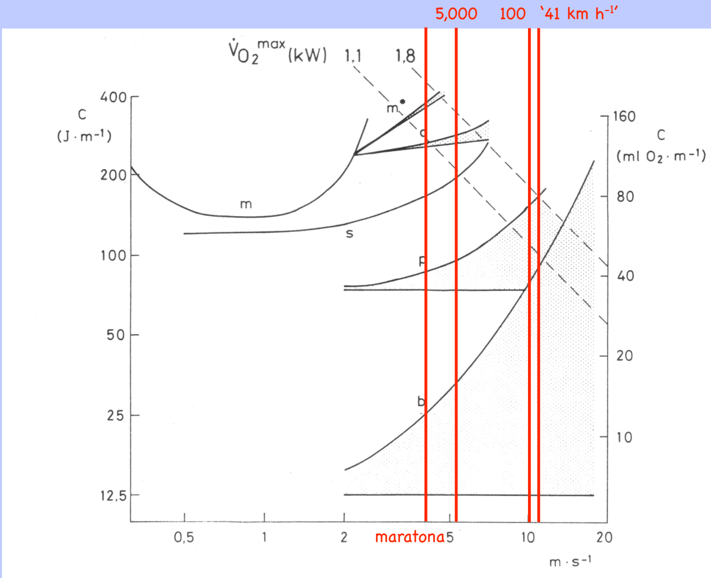


Fig. 3. Relation of O_2 intake and speed in individual athletes (*a*) on the treadmill, and (*b*) on the track (B. Tulloh, × with shoes and ○ without shoes). The curves have been extrapolated to resting O_2 intake.

Mezzo
(aria)



C vs. velocità

di Prampero PE (1985) La locomozione umana su terra, in acqua, in aria. FATTI E TEORIE. edi-ermes, Milano.

SUMMARY

1. The relation of $\dot{V}_{O_2}$ and speed was measured on seven athletes running on a cinder track and an all-weather track. The results were compared with similar observations on four athletes running on a treadmill.

2. In treadmill running the relation was linear and the zero intercept coincided with resting $\dot{V}_{O_2}$.

3. In track running the relation was curvilinear, but was adequately represented by a linear regression over a range of speeds extending from 8·0 km/hr (2·2 m/sec) to 21·5 km/hr (6·0 m/sec). The slope of this line was substantially steeper than the regression line slope for treadmill running.

4. The influence of air resistance in running was estimated from measurements of $\dot{V}_{O_2}$ on a subject running on a treadmill at constant speed against wind of varying velocity.

5. The extra O_2 intake ($\Delta\dot{V}_{O_2}$) associated with wind increased as the square of wind velocity. If wind velocity and running velocity are equal, as in running on a track in calm air, $\Delta\dot{V}_{O_2}$ will increase as the cube of velocity.

6. It was estimated that the energy cost of overcoming air resistance in track running is about 8% of total energy cost at 21·5 km/hr (5000 m races) and 16% for sprinting 100 m in 10·0 sec.

J. Physiol. (1971), **213**, *pp.* 255–276
With 9 text-figures
Printed in Great Britain

THE INFLUENCE OF WIND RESISTANCE IN RUNNING AND WALKING AND THE MECHANICAL EFFICIENCY OF WORK AGAINST HORIZONTAL OR VERTICAL FORCES

By L. G. C. E. PUGH

From the Laboratory for Field Physiology, National Institute for Medical Research, Holly Hill, London, N.W. 3

(*Received 8 April 1970*)

SUMMARY

1. O_2 intakes were determined on subjects running and walking at various constant speeds, (*a*) against wind of up to 18·5 m/sec (37 knots) in velocity, and (*b*) on gradients ranging from 2 to 8%.

2. In running and walking against wind, O_2 intakes increased as the square of wind velocity.

3. In running on gradients the relation of O_2 intake and lifting work was linear and independent of speed. In walking on gradients the relation was linear at work rates above 300 kg m/min, but curvilinear at lower work rates.

4. In a 65 kg athlete running at 4·45 m/sec (marathon speed) $\dot{V}_{O_2}$ increased from 3·0 l./min with minimal wind to 5·0 l./min at a wind velocity of 18·5 m/sec. The corresponding values for a 75 kg subject walking at 1·25 m/sec were 0·8 l./min with minimal wind and 3·1 l./min at a wind velocity of 18·5 m/sec.

5. Direct measurements of wind pressure on shapes of similar area to one of the subjects yielded higher values than those predicted from the relation of wind velocity and lifting work at equal O_2 intakes. Horizontal work against wind was more efficient than vertical work against gravity.

6. The energy cost of overcoming air resistance in track running may be 7·5% of the total energy cost at middle distance speed and 13% at sprint speed. Running 1 m behind another runner virtually eliminated air resistance and reduced $\dot{V}_{O_2}$ by 6·5% at middle distance speed.

INTRODUCTION

The influence of wind resistance in running and walking, and the mechanical efficiency of work against horizontal or vertical forces has been discussed in several recent papers on the energetics of athletic performance

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J. Physiol. (1974), **241**, *pp.* 795–808
With 8 text-figures
Printed in Great Britain

THE RELATION OF OXYGEN INTAKE AND SPEED IN COMPETITION CYCLING AND COMPARATIVE OBSERVATIONS ON THE BICYCLE ERGOMETER

BY L. G. C. E. PUGH

From the Laboratory for Field Physiology, National Institute for Medical Research, Holly Hill, London, N.W. 3

(*Received 4 April 1974*)

SUMMARY

1. The relation of $\dot{V}_{O_2}$ and speed was determined on six competition cyclists riding at speeds ranging from 12 km/hr to 41 km/hr on the runway of an airfield. Comparative measurements were made on the bicycle ergometer to determine the corresponding work rates, and from this information rolling resistance and air resistance were derived.

2. $\dot{V}_{O_2}$ was a curvilinear function of cycling speed, and increased from 0·88 l./min at 12·5 km/hr to 5·12 l./min at 41 km/hr, mean body weight being 72·9 kg.

3. On the ergometer, $\dot{V}_{O_2}$ was a linear function of work rate; maximum values up to 5·1 l./min (74·4 ml./kg min) and work rates up to 425 W (2600 kg m/min) were observed.

4. Data are presented on the relation of pedal frequency and speed in cycling, and on the relation of mechanical efficiency and pedal frequency, as determined on the ergometer.

5. The estimated rolling resistance for four subjects was 0·71 kg f. The drag coefficient was 0·79 and the drag area 0·33 m^2. The values agreed well with results obtained by other methods.

6. The energy expenditure (power developed) in cycling increased approximately as the square of the speed, and not as the cube of the speed as expected. This was explained by the varying contribution of rolling resistance and air resistance to over-all resistance to motion at different speeds.

INTRODUCTION

No systematic study of O_2 intake and speed in cycling appears to have been made since the time of Zuntz. Zuntz (1899) measured O_2 intake at three speeds, the highest O_2 intake being 2·5 l./min at 21 km/hr (5·8 m/sec). Others have measured O_2 intakes at one or two speeds in connexion with

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Mezzo

(aria)

(pista, l. m.)

$$R_a = b\dot{s}^2 = D$$

$$R = R_r + b\dot{s}^2 \quad A_D = C_D A_p$$

$$C_D = D/(.5 \text{ rho } A_p v^2)$$

$$C_D = b/(.5 \text{ rho } A_p) = b/(.0625 A_p)$$

(aria calma)

ciclismo

$$A_D = b/.0625 \ (m^2)$$

Mezzo

(aria)

(pista, l. m.)

Resistenza aerodinamica in pista

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(61.3 kg)

Disponibili tirocini, tesi triennale e specialistica (1: 5)

- Recupero corsa in avanti vs. corsa all'indietro;

- bioenergetica della corsa prolungata in pista e su treadmill;

- bioenergetica & biomeccanica della corsa prolungata (MF);

- bioenergetica & biomeccanica dell'in-line skating (MpF);

- bioenergetica & biomeccanica dell'handbiking (PhD p);

Disponibili tirocini, tesi triennale e magistrale (2: 6)

- bioenergetica & biomeccanica dell'handbiking dopo RMET (PhD p);

- bioenergetica & biomeccanica dell'handbiking dopo HIT (PhD p);

- bioenergetica & biomeccanica dopo long bed rest (MF);

- bioenergetica & biomeccanica del nordic running;

- bioenergetica & biomeccanica di vari trekking (MF);

- costo metabolico marcia, corsa, ciclismo e sci di fondo stessi soggetti;

Disponibili tirocini, tesi triennale e magistrale (3: 5)

- costo EMG della marcia (MF);

- frequenza di skipping e costo metabolico della corsa (MpF);

- review dei sistemi di misura portatili dell'attività fisica e del dispendio metabolico (C);

- salto in lungo da fermo con masse aggiunte ed allenamento;

- bioenergetica e biomeccanica della regata velica.