Laurea specialistica in Scienze e tecniche dello sport

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

La locomozione e le 'interferenze' ambientali

Martedì 12 Aprile h. 15:30÷17 Biomeccanica del movimento e dello sport ARDIGO' 22

Luca P. Ardigò

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.)

ciclismo

$\dot{V}_{O2}$ vs. velocità

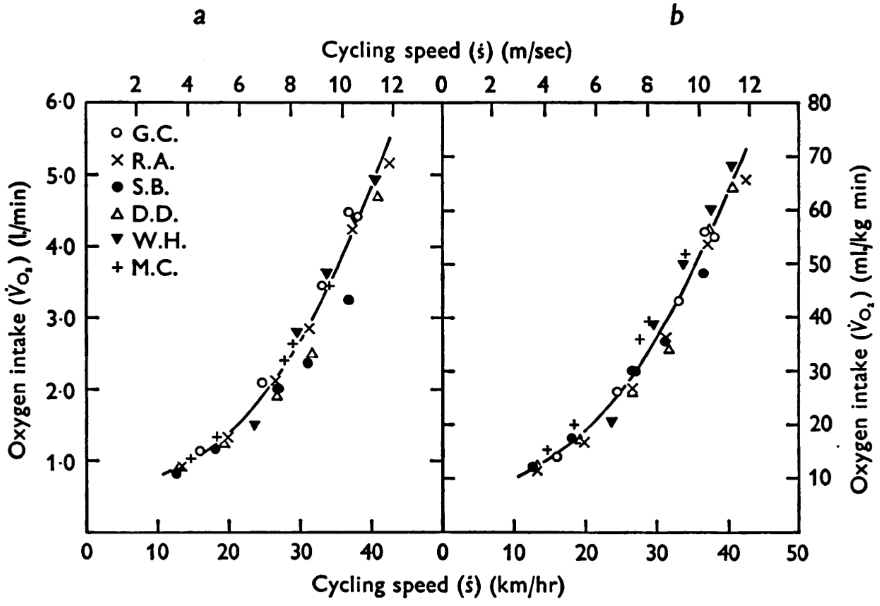


Fig. 1. Relation of oxygen intake and cycling speed for six competition cyclists.

Mezzo
(aria)
(pista, l. m.)

ciclismo

'$\dot{V}_{O2}$' vs. velocità

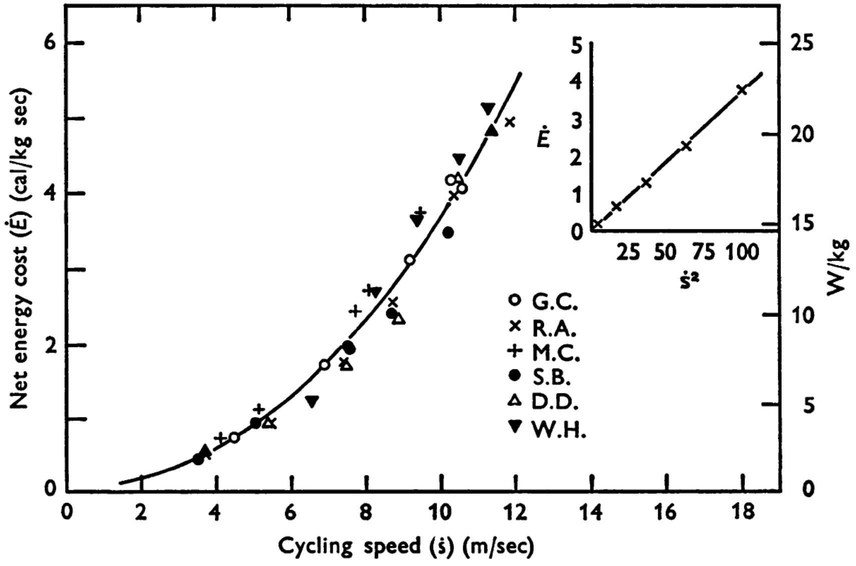


Fig. 2. Relation of net energy expenditure and cycling speed for six competition cyclists. Inset is a plot of energy expenditure against the square of speed.

Mezzo
(aria)
(pista, l. m.)

ciclismo

freq vs.
velocità

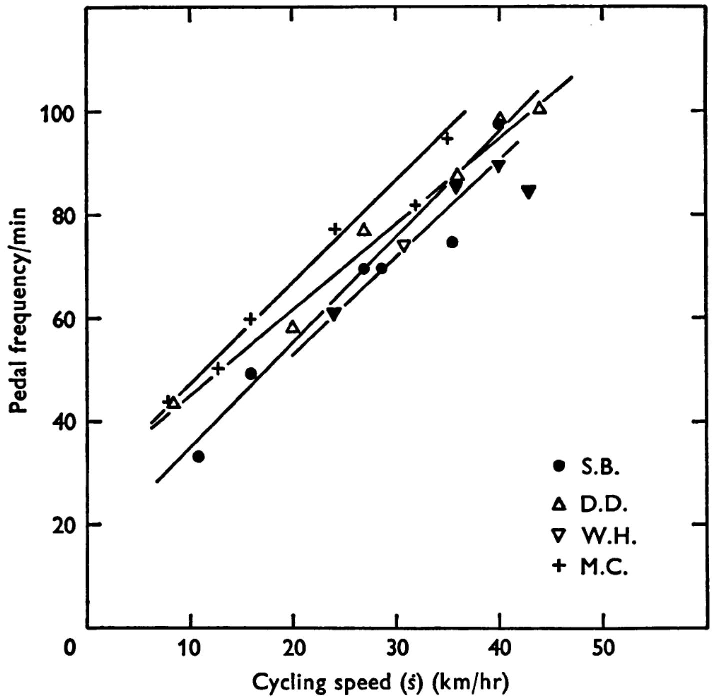


Fig. 3. Relation of pedal frequency and cycling speed.

Mezzo

(aria)

(pista, l. m.)

ciclismo

$\dot{V}_{O2}$ vs. velocità

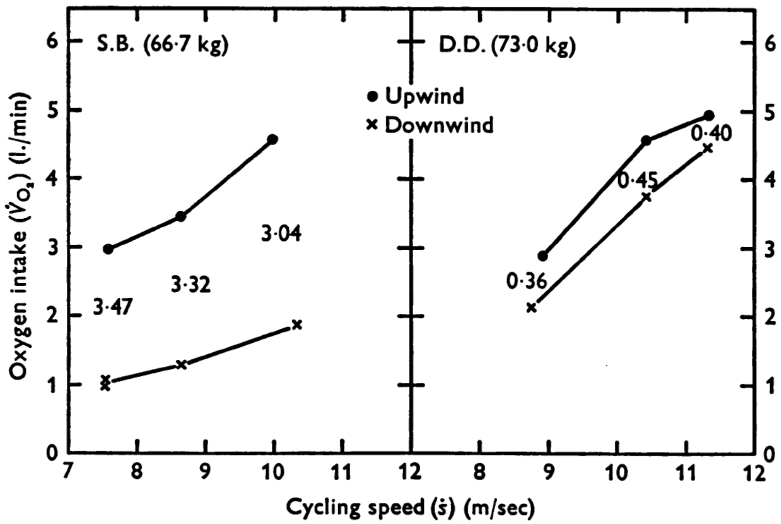


Fig. 4. Effect of wind on oxygen intake in cycling. The numbers indicate mean effective wind velocity in m/sec.

Mezzo
(aria)
(cicloergometro, l. m.)

ciclismo

$\dot{V}_{O2}$ vs. potenza meccanica

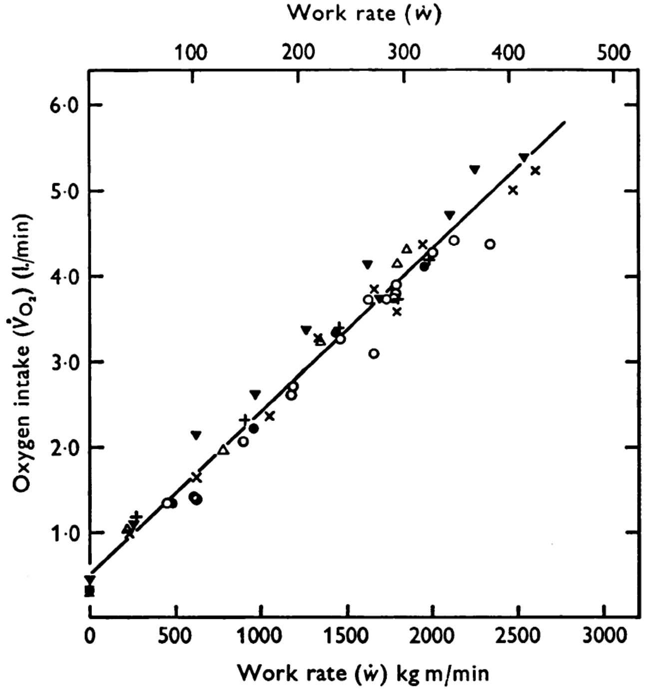


Fig. 5. Relation of oxygen intake and work rate on the ergometer. Symbols as in Fig. 1.

Mezzo
(aria)
(l. m.)

ciclismo

freq vs $\dot{V}_{O2}$

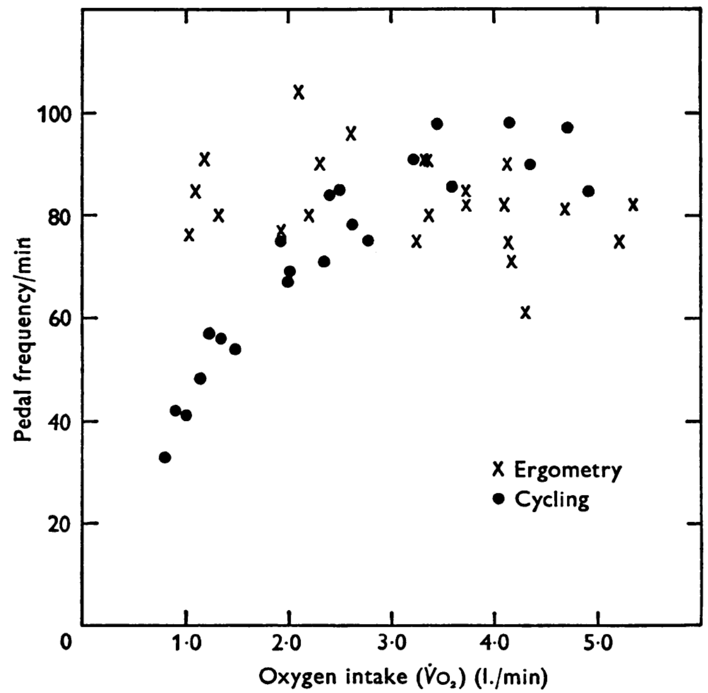


Fig. 6. Comparison of pedal frequencies in cycling and ergometer exercise.

Mezzo

(aria)

(cicloergometro, l. m.)

ciclismo

eff vs. potenza meccanica

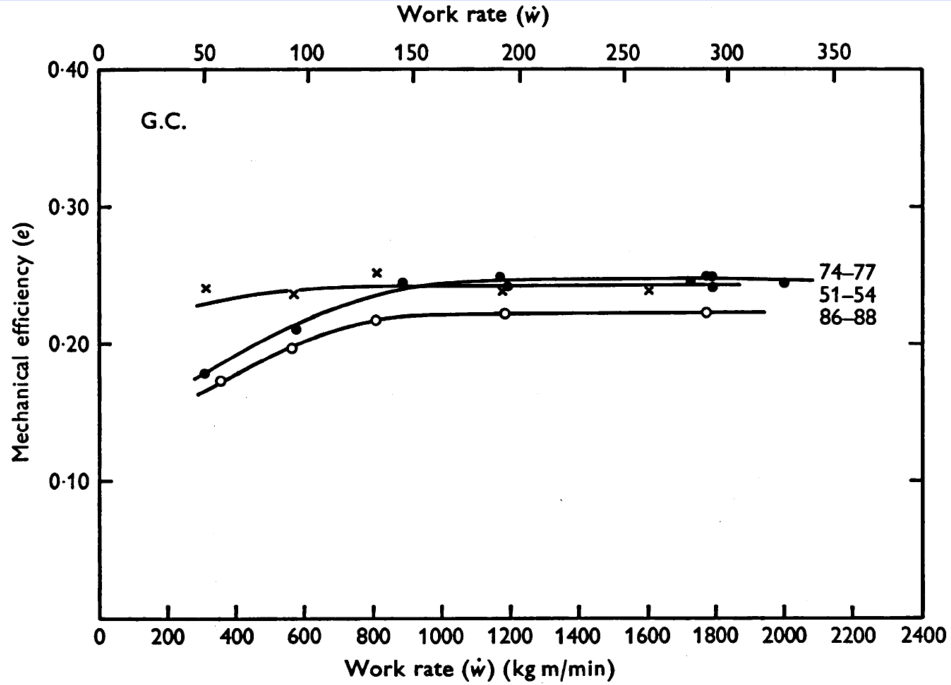


Fig. 7. Mechanical efficiency at various work rates and pedal frequencies. Subject G.C. Numbers indicate pedal frequencies.

Mezzo
(aria)
(l. m.)

ciclismo

$\dot{V}_{O2}$ vs. velocità/potenza meccanica

R vs. velocità^2

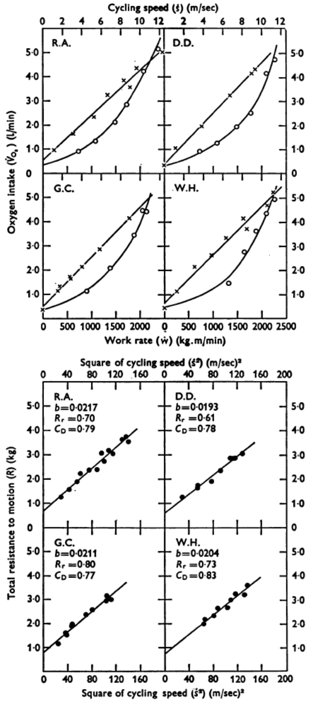


Fig. 8. *a*, Relation of oxygen intake and speed, and oxygen intake and work rate, for four subjects; *b*, relation of total resistance to motion (R) and the square of road speed ($\dot{s}^2$) estimated from the results shown in *a*.

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.

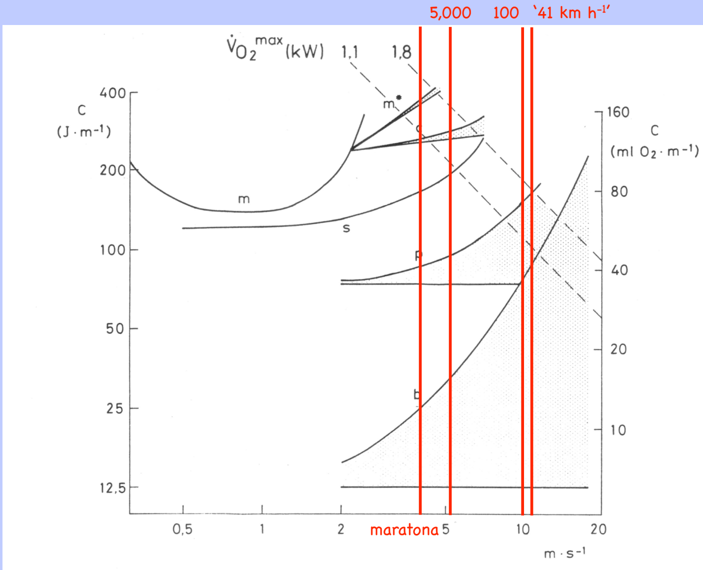
4. Data are presented on the relation of pedal frequency and speed in cycling, and on the relation of mechanical efficiency and pedal frequency, as determined on the ergometer.

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.

Mezzo
(aria)

C vs. velocità

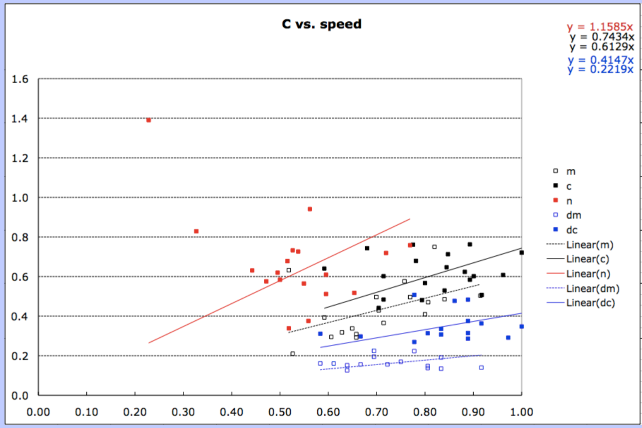


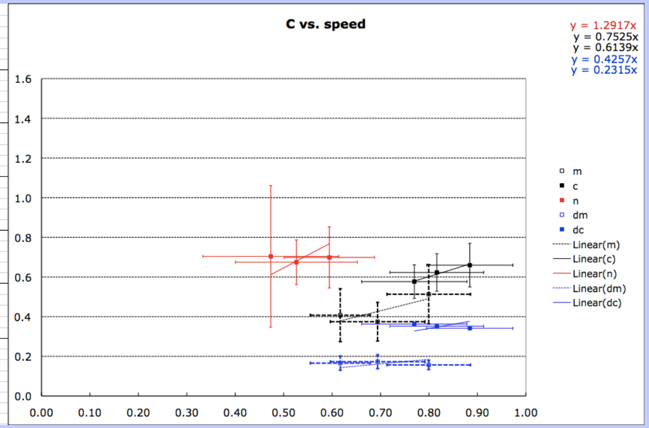
di Prampero PE (1985) La locomozione umana su terra, in acqua, in aria. FATTI E TEORIE. edi-ermes, Milano.

Mezzo
(acqua, 50% h)

marcia, corsa e nuoto

C vs. velocità

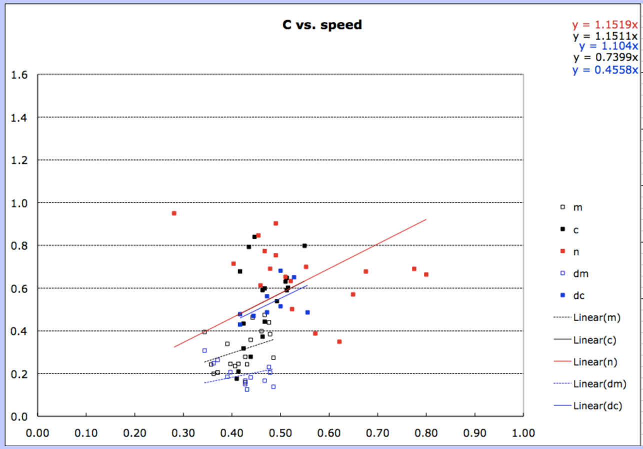


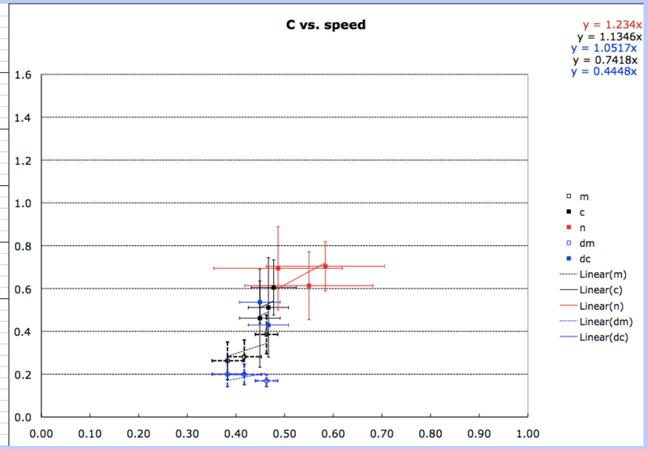


Mezzo
(acqua, 75% h)

marcia, corsa e nuoto

C vs. velocità





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CASE REPORT

Physiological Adaptation of a Mature Adult Walking the Alps

Luca P. Ardigò, PhD; Giuseppe Lippi, MD; Gian Luca Salvagno, MD; Federico Schena, MD, PhD

From the Faculty of Motor and Sport Science, Department of Neurological, Neuropsychological, Morphological and Movement Sciences, Verona University, Verona, Italy (Dr Ardigò and Dr Schena); the Clinical Chemistry and Hematology Laboratory, Academic Hospital of Parma, Parma, Italy (Dr Lippi); and the Section of Clinical Chemistry, Department of Morphological-Biomedical Sciences, Faculty of Medicine and Surgery, Academic Hospital of Verona, Verona, Italy (Dr Salvagno).

Research on endurance locomotion has mainly focused on elite athletes rather than common middle-aged subjects. Our report describes the physiological and hematological adaptation of a healthy, active 62-year-old man who trekked alone along a 1300 km/3 month course of Alpine paths (Via Alpina). The following procedures were conducted: pre- and post-trekking and fortnightly field anthropometry (total and lean body mass), functional tests (isometric maximal voluntary force, spontaneous walking speed, relative metabolic cost, and peak oxygen consumption) and clinical chemistry/hematological measurements with laboratory instruments; daily self-administered effort measurements using portable devices along the route (walked distance, ascent, descent, time, metabolic consumption, and cost). Despite the tough trekking route, the subject completed the trek without any worsening of his performance, or any significant health or functional problems. In addition, his peak oxygen consumption increased by 13.2%. His successful adaptation may be attributed to his constant, repeated middle-intensity and extensive exercise and lengthy exposure to high altitude. The clinical chemistry/hematological measurements documented his physiological adaptation. In conclusion, we show how an active, middle-aged man can successfully face endurance trekking, not only without any harm to his health or functions but also with an increase in his capacity to support specific effort.

Key Words: physical endurance, walking, middle-aged, physiological adaptation

Introduction

Both endurance walking and running are used in basic life functions, such as retrieving food, colonizing new habitats, mating, and escaping hazards.[1–3] Walking and running have been included in modern exercise recommendations by several authoritative guidelines.[4] It is widely acknowledged that the study of extremes helps us understand general biological phenomena. Extreme conditions, including endurance performances, refer to long-distance racing,[1,5–10] challenging environmental conditions (eg, desert, mountain, and polar expeditions[1,5,8,9,11]), and strenuous physical activity (eg, man-hauling[1,8,11]). Investigations into endurance methods in extreme conditions have included walking,[1,8] running,[1,5,7–9] swimming, [9] cycling,[1,6,7,12] kayaking,[9] and multi-discipline races.[9] The research into extreme endurance locomotion has involved both able-bodied and disabled subjects.[6]

Traditionally, these studies tend to enlist top athletes. However, studying the physiological characteristics of amateurs may reveal traits which may benefit nonelite athletes. The aim of this investigation is to describe the physiological changes that were recorded in a 62-year-old man who trekked a very long distance (> 1300 km) following the mountain path route that is known as the Via Alpina.[14]

Methods

THE SUBJECT

The subject is an Italian male, aged 62, with a body mass of 75 kg, height 178.5 cm, and BMI of 23.5 (pre-trekking measurements). He is retired and physically active, mainly performing downhill skiing, open water (sea) swimming, and trekking. Testing procedures were ex-

Corresponding author: Luca P. Ardigò, PhD, via Felice Casorati 43, Faculty of Motor and Sport Science, Verona University, Verona, Italy 37131 (e-mail: luca.ardigo@univr.it).

Research on endurance locomotion has mainly focused on elite athletes rather than common middle-aged subjects. Our report describes the physiological and hematological adaptation of a healthy, active 62-year-old man who trekked alone along a 1300 km/3 month course of Alpine paths (Via Alpina). The following procedures were conducted: pre- and post-trekking and fortnightly field anthropometry (total and lean body mass), functional tests (isometric maximal voluntary force, spontaneous walking speed, relative metabolic cost, and peak oxygen consumption) and clinical chemistry/hematological measurements with laboratory instruments; daily self-administered effort measurements using portable devices along the route (walked distance, ascent, descent, time, metabolic consumption, and cost). Despite the tough trekking route, the subject completed the trek without any worsening of his performance, or any significant health or functional problems. In addition, his peak oxygen consumption increased by 13.2%. His successful adaptation may be attributed to his constant, repeated middle-intensity and extensive exercise and lengthy exposure to high altitude. The clinical chemistry/hematological measurements documented his physiological adaptation. In conclusion, we show how an active, middle-aged man can successfully face endurance trekking, not only without any harm to his health or functions but also with an increase in his capacity to support specific effort.

Key Words: physical endurance, walking, middle-aged, physiological adaptation

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.