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Abstract

The purpose of this study was to apply the "critical velocity" concept to short intermittent high-intensity running exercises in prepubescent girls and boys, and to compare running performances obtained either by intermittent or continuous exercise runs. Eleven 8 to 11-year-old children underwent a maximal graded field test to determine peak oxygen uptake (peakVO$_2$) and maximal aerobic velocity (MAV). During the six following sessions, they randomly performed three continuous runs (90%, 100%, and 110% of MAV) and three intermittent runs (120%, 130%, and 140% of MAV) until exhaustion. Intermittent exercises consisted of repeated 15-s runs each one separated by a 15-s passive recovery interval. For continuous as well as for intermittent exercises, distance versus time to exhaustion (TTE) relationships were calculated to determine continuous (CVc) and intermittent (CVi) critical velocities. Values for peakVO$_2$, and MAV were 45.8±5.3 ml.kg^{-1}.min^{-1} and 10.5±1.0 km.h^{-1}, respectively. For the whole population, a significant relationship was found between distance to exhaustion and TTE for continuous (r^2=0.99, $p<0.05$) and intermittent exercises (r^2=0.99, $p<0.05$). Significant relationships were found between peakVO$_2$ and both CVc (r^2=0.60, $p<0.01$) and CVi (r^2=0.47, $p<0.05$). In conclusion, as for continuous exercises, a linear relationship was found between DTE and TTE for short high-intensity intermittent exercises. CVc was significantly related to peakVO$_2$, while a significant lower relationship was found between peakVO$_2$ and CVi.

Keywords: Anaerobic Capacity, Critical Power, Maximal Oxygen Uptake, Performance Model

Introduction

For training purposes, exercise individualization is a key factor in physical fitness improvement. For aerobic exercises, parameters such as: percentage of maximal oxygen uptake, percentage of velocity at lactate/ventilatory thresholds, percentage of heart rate reserve or percentage of maximal aerobic velocity (MAV) have been mainly used to adapt exercises to the physiological features of each individual. The knowledge of exercise time to exhaustion (TTE) is also of particular interest when the question is to adapt exercise duration not only for each individual, but also for specific populations (Laursen et al., 2002). For instance, Berthoin et al. (1996) demonstrated that TTE at 100% of MAV increased with age from childhood to adulthood, suggesting that for a same relative velocity (%MAV) acceptable running time should be adapted in relation with the age of the children. To the best of our knowledge, no study has investigated this topic in children during intermittent exercises.

Intermittent exercises are defined by their intensity and duration, recovery intensity and duration, number of repetitions and even number of series. Like continuous exercises, intermittent exercises allow children to increase their aerobic fitness (Baquet et al., 2003). Contrary to continuous exercises, intermittent exercises not mainly depend on maximal aerobic fitness and energy cost of running, but also on and anaerobic capacity, rest to exercise transitions, and exercise to rest transitions. Compared to adults, children show specific physiological adaptations to exercise, such as: a faster rest to exercise oxygen uptake transitions (Fawkner and Armstrong, 2002), a faster recovery (Hebestreit et al., 1993), a lower anaerobic capacity (Gaul et al., 1995), a higher ability to repeat supramaximal exercises (Ratel et al., 2002) or differences in ratings of perceived exertion as a function of exercise duration (Timmons and Bar-Or, 2003). All of these factors may have a significant influence on intermittent performances. Thus, specific investigations have to be conducted on intermittent performance in order to adapt intermittent exercises modalities to pediatric population.

The knowledge of TTE is an easy way to indicate which exercise duration, at a selected intensity, is acceptable for an individual. However, it is not possible to measure multiple TTE. For continuous exercises, an alternative is to calculate general models of performance based on the linear relationships between exercise distance to exhaustion (DTE) and TTE. The latter was the start of the "critical power" concept initiated by Scherrer et al. (1954). These authors demonstrated that for local upper limb exercises performed until exhaustion, a linear relationship was found between work and time. Subsequent studies have successfully applied this model to general movements (see Hill, 1993 for review). For running exercises where distance and velocity are used instead of work and time, the expression "critical velocity" is commonly used instead of "critical power". Knowing the relationship between DTE and TTE, it is possible to estimate individual performances over a wide range of distances or time (Figure 1). In children, this concept has been applied to continuous exercises: swimming (Denadai et al., 2000; Hill et al., 1995), cycling (Fawkner and Armstrong, 2002), and running (Berthoin et al., 2003). Few studies have applied the "critical velocity" concept to intermittent exercises (Dupont et al., 2002; Kachouri et al., 1996). However, to date, only adults have been investigated.

This study was designed to compare continuous and high-intensity intermittent exercises in children. It was hypothesized that the "critical velocity" concept could be successfully applied to 15s/15s intermittent exercises.

Methods

Subjects

Eleven 8- to 11- year- old children (4 boys and 7 girls) volunteered to participate in this study, which had received approval from the Local Committee for Person's Protection in Biomedical Research. The children and their parents signed a written informed consent in accordance with the ethical standards of the Helsinki Declaration of 1975. Height and body mass were measured with a wall stadiometer (Vivioz Medical) and a calibrated beam balance (Tanita TBF 543). Percentage body fat was estimated from skinfold thickness measured at three sites (biceps, triceps and calf), according to Lohman (1992). Sexual maturity was evaluated from pubertal stages: indices of breast, pubic hair and genital development (Tanner, 1962). The same physician made all observations visually, before the training period. At the beginning of the study, all subjects were at Tanner stage 1. Mean values for age, mass, height, and percentage body fat were: 9.5±0.8 years, 37.9±10.6kg, 1.36±0.08m, and 23.0±4.7%, respectively.

Overview

Before entering the study, the children were familiarized with the testing modalities and the gas analyzer device. Then, they performed seven maximal field tests over a three-week period: one graded test, three continuous tests, and three intermittent tests at the same time of the day (±1h). All tests were performed outdoors with ambient temperature ranging from 16 to 22°C. During the first test, peakVO$_2$ and MAV were investigated. The continuous and intermittent tests were performed in a random order. During all tests, the children were verbally encouraged to run until exhaustion. To avoid any problem linked to a child's inability to maintain a selected speed, he or she always ran with an adult. In all cases, the test ended when the children could no longer maintain the required running velocity.

Maximal graded test

The test started with an initial velocity of 6 km.h^{-1}, then the speed was increased by 1.5 km.h^{-1} per 3-min stage. The speed at the last completed stage, increased by 0.5 km.h^{-1}, if the child was able to run 1 min, or by 1 km.h^{-1}, if he or she was able run 2 min, was considered as the MAV. During the test, the velocities were monitored with a computer. This test was performed on a 150-m track marked with cones every 25 m. The computer emitted a brief sound that indicated to the children the moment when they had to pass near a cone to maintain a constant speed. During the graded test, respiratory gas exchange values were measured breath-by-breath using a portable system (Cosmed K4b^2, Rome, Italy) (McLaughlin et al., 2002) in order to determine ventilation (VE), oxygen uptake (VO_2), and carbon dioxide production (VCO_2). Before each test, the O_2 and CO_2 analysis systems were calibrated using ambient air and a gas of known O_2 (16%) and CO_2 (5%) concentrations. The calibration of the turbine flowmeter of the K4 b^2 was performed using a 3-l syringe (Quinton Instruments, Seattle, Wash., USA). Cardiorespiratory parameters were averaged on 15 s periods. Heart rate (HR) was continuously monitored (Polar, Kempele, Finland). This compact device was easy to attach without constricting the children's movements. PeakVO_2 was determined as the highest 15-s VO_2 value. VO_2 was accepted as a maximal index when 3 of the following criteria were met: a levelling off of VO_2 despite a further increase in velocity, a final HR above 195 bpm, a respiratory exchange ratio (RER) > 1, a visible exhaustion (Tolfrey et al., 1998).

Continuous and intermittent tests

During continuous and intermittent tests, only HR was measured. For TTE, HR was continuously monitored. The tests were preceded by a 3-min warm-up at 6 km.h^{-1} immediately followed by a 1-min rest period. For the continuous runs, the velocities were set at 90%, 100%, and 110% of MAV (TTEc90, TTEc100, TTEc110). The intermittent exercises were repeated until exhaustion using 15-s runs at 120%, 130% or 140% of the MAV, alternated with 15-s of passive recovery periods (TTEi120, TTEi130, TTEi140). The choice for exercise intensities (%MAV) was based on previously published results (Berthoin et al. 1996; Berthoin et al., 2003; Dupont et al., 2002) and a preliminary study so that continuous and intermittent exercises lead to exhaustion over similar durations. For continuous tests, velocities were set as for the graded test. For the intermittent exercises, running paces were given by a manual timer producing a sound every 15-s from the start to the end of the exercise. During the 15-s exercise period, the children had to cover a distance, marked with two cones, and determined according to their own MAV. The distance between the two cones set the exercise distance to be covered in 15-s at the selected velocity. After a 15-s rest, they started to run again in the opposite direction for 15-s (Figure 2). For each exercise, the running time was measured to the nearest second. For the intermittent exercises, recovery periods were not included into the calculation of TTE. The maximal values for HR were retained as peak HR (peakHR).

Models of performance

According to Ettema (1966), the individual linear relationships between DTE and TTE were calculated for each subject as: DTE = (CV.TTE) + ADC, where critical velocity (CV, in $m.s^{-1}$) is the slope of the relationship, and anaerobic distance capacity (ADC in m) is the intercept of the relationship. The relationships were calculated for continuous exercises (CVc, and ADCc) and for intermittent exercises (CVi, ADCi). Based on the model of Péronnet and Thibault (1986), we also calculated individual relationships between %MAV and the logarithm of time to exhaustion for both continuous and intermittent runs: %MAV=a.ln(TTE)+b. To provide equivalence between continuous and intermittent runs, it was assumed that if the latter induced exhaustion in identical times, they should require an identical energetic demand. For this calculation intermittent TTE included recovery times.

Statistical analysis

Results are expressed as means ± SD. Repeated measures analysis of variance with Schéffé post-hoc comparisons were used to determine differences in mean peakHR, DTE, and TTE between tests. Mean values for CV and ADC between exercise modalities were compared with the Student *t*-test after verification for distribution normality. Pearson-product moment correlation coefficients were also used to assess the relationship between variables. In all analyses, the level of significance was set at $p<0.05$.

Results

Mean maximal values measured during the graded field test for VO_2, VE, HR, RER, and MAV were: 45.8±5.3 $ml.kg^{-1}.min^{-1}$, 64.8±13.8 $l.min^{-1}$, 199±7 bpm, 1.12±0.09, and 10.5±1.0 $km.h^{-1}$, respectively. Times to exhaustion, DTE, and peakHR for continuous and intermittent exercises are presented in Table 1. A significant time effect was observed for peakHR. Post-hoc analysis only revealed that peakHR for TTEi120 was significantly lower than for TTEc100. For continuous exercises, the mean for individual coefficients of determination (r^2) between DTE and TTE was 0.996±0.006 ($0.983<r^2<1.0$, $0.003<p<0.084$), while for intermittent exercises the mean value was 0.998±0.003 ($0.991<r^2<1.0$, $0.002<p<0.060$). Correlations failed to reach significance in three cases for continuous exercises ($0.983<r^2<0.989$, $0.067<p<0.084$), and in one case for intermittent exercises ($r^2=0.991$, $p=0.060$). The relationships between DTE and TTE, for continuous and intermittent runs, are presented on Figure 3. Mean values for CVc and CVi were 9.0±1.0 $km.h^{-1}$ (85.5±3.8 %MAV) and 11.4±1.2 $km.h^{-1}$ (108.0±6.1 %MAV), respectively. A significant relationship ($r^2=0.86$, $p<0.001$) was noticed between CVc and CVi (Figure 4). Significant relationships were also found between CV, peakVO_2, and MAV (Figure 5). There was no significant difference between mean values for ADCc (111±35 m) and ADCi (137±52 m), but the latter were not significantly correlated ($p=0.36$). Similarly, no correlation was observed between ADCc (or ADCi), and peakVO_2 or MAV. High coefficients of determination were found between %MAV and the logarithm of TTE for continuous exercises ($r^2=0.965±0,037$, $0.902<r^2<0.999$, $0.002<p<0.203$) and intermittent exercises ($r^2=0.976±0.027$, $0.911<r^2<0.999$, $0.015<p<0.192$). Mean relationships between %MAV and TTE are illustrated on Figure 6. Based on the assumption that similar TTE between continuous and intermittent denoted mean similar energetic demand, a correspondence between continuous (%MAVc) and intermittent (%MAVi) velocities could be proposed as: $\%MAVc = 0.78\%MAVi - 4$.

Discussion

The main result of the study was, that in prepubertal children, a linear relationship was observed between DTE and TTE for 15s/15s intermittent exercises. This suggests that the "critical velocity" model may successfully be applied in children performing intermittent exercises. Moreover, it allows the estimation of children's intermittent performance over a wide range of intensities during specific intermittent exercises (15-s exercises interspersed with 15-s of passive recovery). Our results also suggest that CVc, and too lesser extend CVi, are good index of aerobic fitness.

In this study four boys and seven girls were investigated. Even if this population was heterogeneous with regard to gender, previous studies on age-matched populations have shown no significant difference between prepubertal boys and girls MAV or TTEc100 (Berthoin et al., 1996). For continuous running TTE, mean performances were similar to those reported in children of comparable fitness and age (Berthoin et al., 1996; Berthoin et al., 2003). However, TTE values were lower than those observed in adult studies (Billat et al., 1995). In children, this may be linked to their lower anaerobic capacity (Van Praagh and Doré, 2002), and higher energy cost of running (Daniels et al., 1978), despite similar peak oxygen uptake (Falgairette et al., 1991). In adults, only one study has been conducted with a similar design for intermittent exercises, i.e. 15-s runs at 110%, 120%, 130%, and 140% of MAV interspersed with 15-s of passive recovery periods (Dupont et al., 2002). In the latter study, the TTE values reported for adults were shorter than those measured in the present study, at 120% of MAV (347±234s vs 421±121s, respectively), 130% of MAV (167±70s vs 233±57s), and 140% of MAV (100±50s vs 136±34s). The longer TTE observed in children could partly be explained by a faster adjustment of oxygen uptake to oxygen requirement at the onset of exercises (Fawkner and Armstrong, 2002), by a faster recovery after high intensity exercises (Hebestreit et al., 1993), which could partly be explained by the children's ability to regulate the changes in acid-base balance more efficiently (Ratel et al., 2002). Another plausible cause might be related to the variation in running speed during field-based high-intensity intermittent exercises. For this exercise modality, the child starts and ends the 15s run at zero velocity, and thus has to accelerate and decelerate. Dupont et al. (2002) have shown that, for an individual running at 120% of MAV (19.2 km.h^{-1} for a MAV of 16 km.h^{-1}), the maximal velocity reached during the 15-s runs represented around 135% of MAV. The 15s/15s exercises are made up of accelerations, decelerations, stops, turns and starts, and the modifications in running rhythms are increasingly constraining as the velocity increases. Therefore, as expected in the present study, the energetic requirements to accelerate and decelerate will be lower for individuals with a low MAV, and thus for children, when compared to adults. These differences in performances between children and adults underline the necessity to develop specific guidelines for children's responses to intermittent exercises.

Contrary to continuous exercises, few studies have been conducted in the scientific literature dealing with the ability of children to repeat short high-intensity intermittent exercises. The intermittent TTE values reported in the present study could be used as first guidelines to set which duration of exercises is tolerable for children when performing 15s/15s high-intermittent exercises.

Performance model

In the present study high coefficients of determination were found between DTE and TTE for continuous running (r^2=0.99). These coefficients were similar to those reported in children for swimming (Hill et al., 1995), cycling (Fawkner and Armstrong, 2002) or running (Berthoin et al., 2003). Similarly, high coefficients of determination were found for intermittent exercises (r^2=0.99). These coefficients were in the same range as those found in adults ($0.99<r^2<1.00$,

$p<0.01$), for similar short duration intermittent exercises (Dupont et al., 2002). From these results, it is suggested that, in children, exercises leading to exhaustion in 2 to 10 min, can be retained to calculate the linear DTE *versus* TTE relationships for intermittent as well as for continuous exercises. Individual performances can also be estimated from the linear relationship between %MAV and the logarithm of TTE (Péronnet and Thibault, 1986). High coefficients of determination were found by fitting the children's data with this model, for continuous ($r^2=0.96$) and intermittent ($r^2=0.98$) exercises. Comparing performance models indicated that continuous runs required around 78% of the energetic demand of intermittent runs, this in accordance with the mean value for CVc (9.0±1.0 km.h^{-1}) that represented 79% of CVi (11.4±1.2 km.h^{-1}). For example, this equivalence suggests that continuous running at 90% of MAV requires the same energetic demand as 15s/15s intermittent running at 115% of MAV. Thus, a training session based on 6 times 15s/15s intermittent exercises at 115% of MAV would be similar in terms of energy requirement to the repetition of 3-min bouts of exercises at 90% of MAV. However, this equivalence needs to be investigated further.

Critical velocity

Calculated CVc was comparable to values obtained from TTEc at 90%, 95%, 100%, 105%, and 110% of MAV (9.0 ±1.0 km.h^{-1} or 84%MAV) in children of the same age, and of comparable aerobic fitness (Berthoin et al., 2003). As previously reported for different types of exercises (Berthoin et al., 2003; Fawkner and Armstrong, 2002), peakVO$_2$ was significantly correlated to CVc ($r^2=0.60$, $p<0.01$), suggesting that this parameter is a valid index of aerobic fitness. For intermittent exercises, data have only been reported for adults. For instance, Dupont et al. (2002) reported that for similar intermittent exercises, CVi represented 104% of MAV, which is quite similar to the 109% of MAV reported in this study. To a lower extent than for continuous exercises, a significant relationship was found between peakVO$_2$ and CVi (r^2=0.47, $p<0.05$). Higher significant relationships were also found between CVc and MAV (r=0.92, $p<0.001$) than between CVi and MAV (r=0.84, $p<0.001$). Aerobic performances are mainly determined by peakVO$_2$, energy cost of running, or velocity at ventilatory/lactate thresholds. This is true for both continuous and intermittent exercises. However, for intermittent exercises, additional factors such as adjustments of energy production to energy requirement at the onset of exercises, a faster recovery and a higher anaerobic capacity are factors that may influence performances. The latter may explain the lower coefficients of determination observed between VO$_2$peak and CVi than between peakVO$_2$ and CVc.

Hill et al. (2002) have shown that for cycle ergometer exercises, critical power was the threshold power output above which maximal oxygen uptake (or peakVO$_2$ in children) could be achieved during a continuous exercise due to the appearance of a slow component of VO$_2$. Thus this intensity defines the heavy (no attainment of VO$_2$max), and severe (attainment of VO$_2$max) domains (Hill et al., 2002). To our knowledge no study has been conducted to determine the minimal intensity that allows children to reach peakVO$_2$. Nevertheless it could be assumed that an intensity at least higher than CVc is needed to lead children to reach peakVO$_2$ during continuous exercises, and even an intensity higher than CVi to reach peakVO$_2$ during 15s/15s exercises. Thus if the aim of training is to reach high percentages of peakVO$_2$, or even to reach peakVO$_2$, velocities have to be at least higher than CVc or CVi.

Anaerobic distance capacity

ADCc (121±49m) was not significantly different from ADCi (143±53). In children, ADCc values were lower than the values obtained in adults: 187±86 m (Kachouri et al., 1996) or 216±59 m (Billat et al., 1995). This difference between children and adults is in accordance with the lower values for ADC reported in young swimmers (Hill et al., 1995), and consistent with those obtained when comparing the anaerobic capacity of children and adults, by means of maximal accumulated oxygen deficit measurement (Carlson and Naughton, 1993) or Wingate tests (Armstrong et al., 2000). In general, the results reported in the literature indicate that the determination of the ADC parameter is more protocol-dependent (Hill, 1993) than the determination of CV. Moreover, compared to the strong link between CV, an indicator of aerobic power, ADC values presented a lower correlation compared to indicators of anaerobic capacity (Hill, 1993). The validity of ADC measurement to evaluate children's anaerobic capacity requires therefore further investigation.

In conclusion this study provides original data on children’s intermittent performances. It has been demonstrated that, as for continuous exercises, a linear relationship could be calculated between intermittent DTE and TTE in prepubertal children. This relationship enables one to estimate children’s intermittent performance over a wide range of times (or distances). Thus, it can be of practical interest in adapting intermittent exercise duration (repetition of 15-s runs) to the children’s possibilities.

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Table 1 Mean ± SD values time to exhaustion (TTE), distance to exhaustion (DTE), and peak heart rate for continuous and intermittent exercises.

	Continuous exercises			Intermittent exercises		
Intensity (%MAV)	90	100	110	120	130	140
TTE (s) *	551±173	278±93	137±38	421±121	233±57	136±34
DTE (m) +	1471±414	812±260	440±106	1458±371	888±236	556±136
Peak heart rate (bpm)	199±8	201±5	199±7	194±8	196±8	198±7

*$p<0.05$; TTEc90 ≠ all others, TTEc100 ≠ all others except TTEi130, TTEc110 ≠ all others except TTEi130 and TTEi140, TTEi120 ≠ all others, TTEi130 ≠ all others except TTEi140

+ $p<0.05$; distance for TTEc90 ≠ all others except TTEi120, TTEc100 ≠ all others except TTEi130 and TTEi140, TTEc110 ≠ all except TTEi140, TTEi120 ≠ all except TTEc90, TTEi130 ≠ all except TTEc110 and TTEi140

Legends

Fig.1 Example of a linear relationship between distances to exhaustion (DTE) and times to exhaustion (TTE) calculated from TTE at 90%, 95%, 100%, 105% and 110% of maximal aerobic velocity (MAV: 8.5 km.h^{-1} for this child). The calculated critical velocity (slope of the relationship) is 2.1 m.s^{-1} (7.6 km.h^{-1} or 89% of MAV) and the anaerobic distance capacity (intercept) represents 67 m. From this relationship it could be estimated that the child's performance over 1000 m should be 444 s, and that the best performance over a 300 s run should be 697 m. In other word the child is able to run 5 min (300 s) at around 100% of his or her MAV.

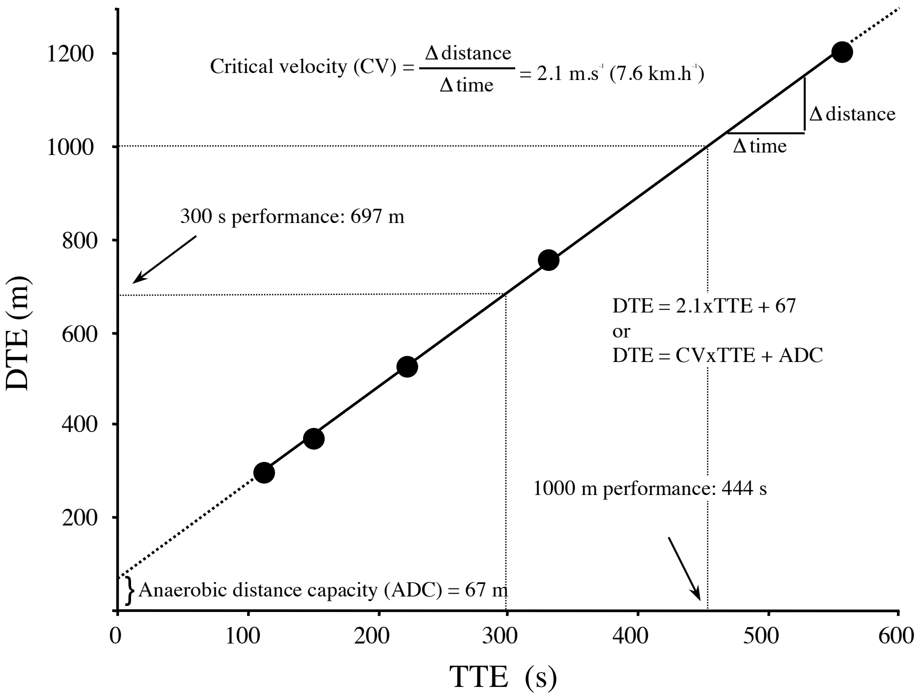
Fig. 2 An example of the organization for intermittent runs for a child with a MAV of 10 km.h^{-1}. The subject had to run between cones separated by either 50-m (120% of MAV), 54.2-m (130% of MAV), or 58.3-m (140% of MAV), and to stop between the two opposite cones. After 15-s passive recovery, the child started the next 15-s run in the opposite direction.

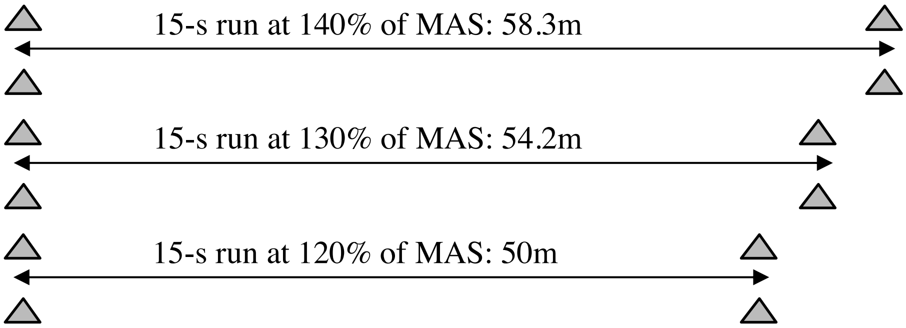
Fig. 3 Mean relationships between distances to exhaustion (DTE) and times to exhaustion (TTE) for continuous (circle) and intermittent (square) exercises.

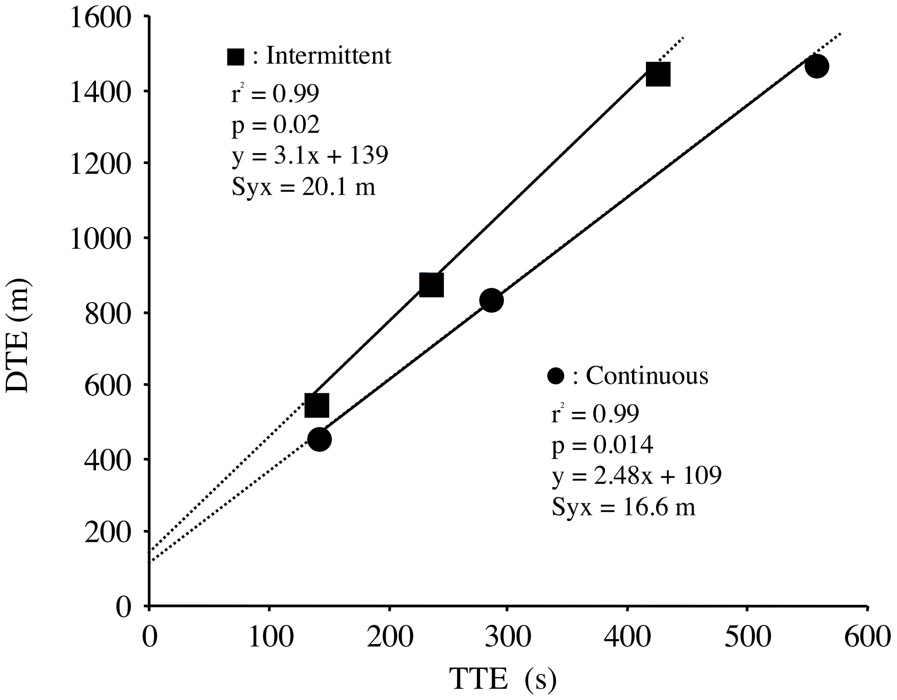
Fig. 4 Relationship between critical velocities calculated for continuous (CVc) and intermittent exercises (CVi).

Fig. 5 Upper left: relationship between continuous critical velocity (CVc) and peak oxygen uptake (peakVO$_2$); Upper right: relationships between intermittent critical velocity (CVi) and peakVO$_2$; Lower left: relationship between CVc and maximal aerobic velocity (MAV); lower right; relationship between CVi and MAV. Dotted line = identity line.

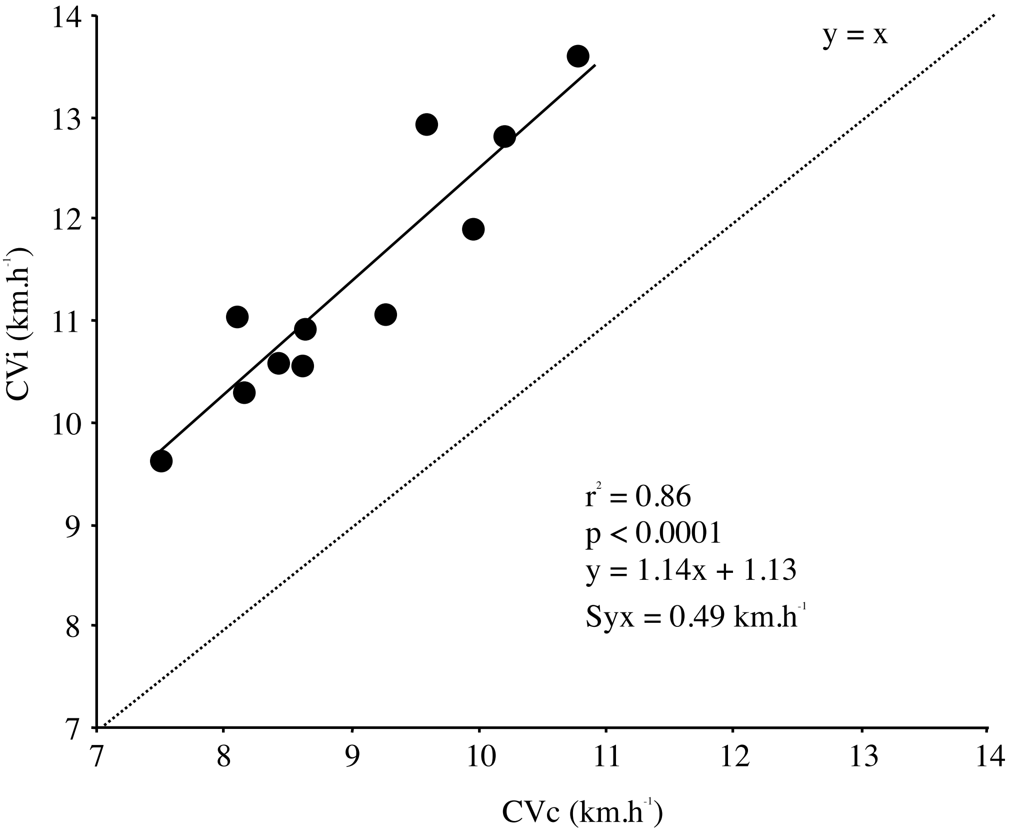
Fig. 6 Relationship between the percentage of MAV (%MAV) and the logarithm of the TTE for the continuous (circle) and intermittent (square) exercises


Critical velocity (CV) = Δdistance / Δtime = 2.1 m.s-1 (7.6 km.h-1)
Δdistance
Δtime
300 s performance: 697 m
DTE = 2.1xTTE + 67
or
DTE = CVxTTE + ADC
1000 m performance: 444 s
Anaerobic distance capacity (ADC) = 67 m
DTE (m)
1200
1000
800
600
400
200
0
100
200
300
400
500
600
TTE (s)

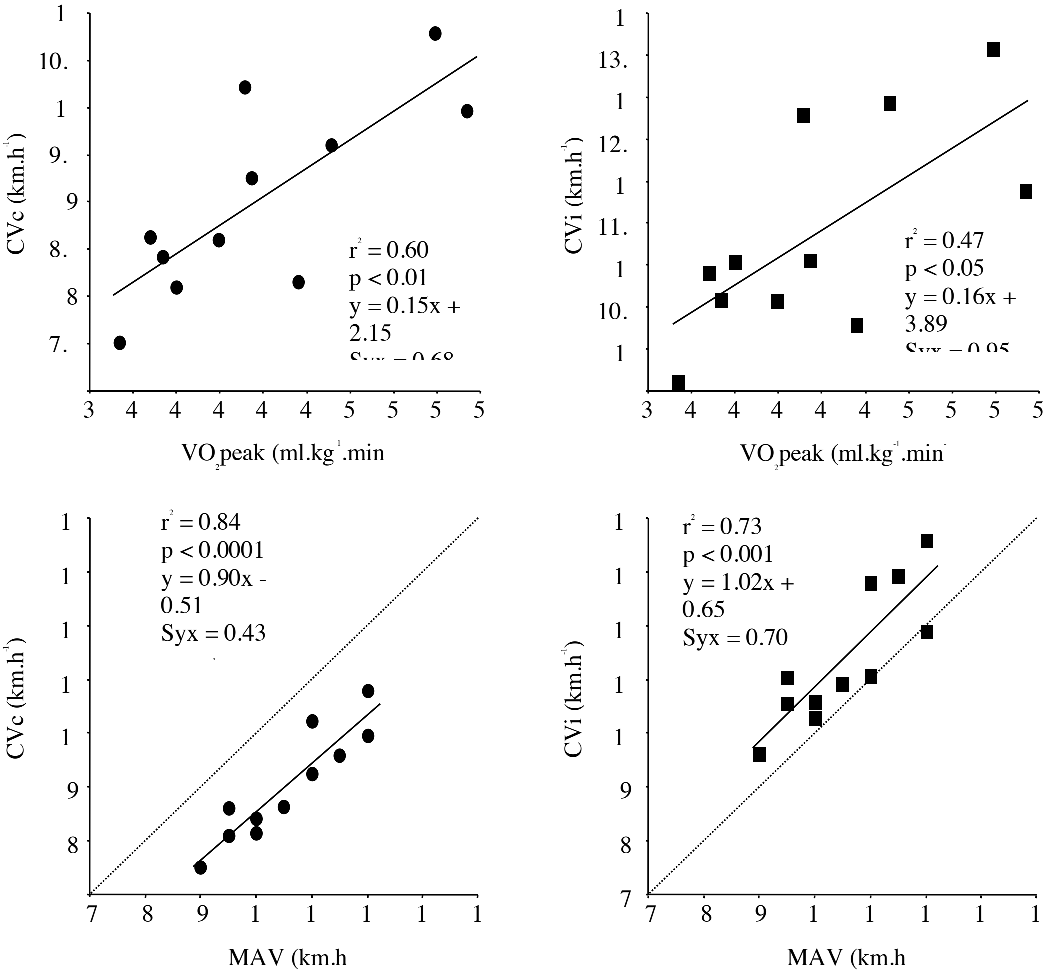

15-s run at 140% of MAS: 58.3m
15-s run at 130% of MAS: 54.2m
15-s run at 120% of MAS: 50m



1600
1400
1200
1000
800
600
400
200
0
DTE (m)
0
100
200
300
400
500
600
TTE (s)
■ : Intermittent
r² = 0.99
p = 0.02
y = 3.1x + 139
Syx = 20.1 m
● : Continuous
r² = 0.99
p = 0.014
y = 2.48x + 109
Syx = 16.6 m



y = x
r² = 0.86
p < 0.0001
y = 1.14x + 1.13
Syx = 0.49 km.h⁻¹
CVi (km.h⁻¹)
CVc (km.h⁻¹)
7
8
9
10
11
12
13
14


CVc (km.h^{-1})
VO$_2$peak (ml.kg^{-1}.min
r^2 = 0.60
p < 0.01
y = 0.15x + 2.15
CVi (km.h^{-1})
VO$_2$peak (ml.kg^{-1}.min
r^2 = 0.47
p < 0.05
y = 0.16x + 3.89
CVc (km.h^{-1})
MAV (km.h
r^2 = 0.84
p < 0.0001
y = 0.90x - 0.51
Syx = 0.43
CVi (km.h^{-1})
MAV (km.h
r^2 = 0.73
p < 0.001
y = 1.02x + 0.65
Syx = 0.70