04 - CRITICAL VELOCITY VERIFICATION THROUGH FOUR VELOCITIES OF AMATEURS RUNNERS

ANDRÉ TEIXEIRA CARDOSO; THIAGO HERNANDEZ MOTA;
RENATO DE OLIVEIRA JESUS; SANDRO FERNANDES DA SILVA.
University of Itaúna/ NAFAP – Itaúna – MG – Brazil.
sandrofs@uit.br

INTRODUCTION

The aerobic component is responsible for providing energy to organisms which exercise for extended time (ZAGATTO et al., 2007). During any physical exercise that takes few minutes, most part of ATP is provided by mitochondrial oxidative phosphorylation, which uses carbohydrates and lipids as fuel. This process requires an adequate supplement of oxygen, provided by blood and proper fuels, which can come from muscle fibers (glycogen and triglycerides) or from glucose and free fatty acids circulation (AZEVEDO et al., 1998).

Nowadays, there are many elaborated and validated protocols to predict long duration performances (DENADAI et al., 2003). The search of new indexes capable to predict human performance is extremely interesting, once starting from these, it's possible to prescribe, in a more efficient way, a training program, besides favoring a more precise evaluation to the effects of the training. (SMITH e JONES, 2001). Among the most studied aerobic performance prediction indexes there are maximal oxygen consumption (VO_{2Max}), maximal lactate steady state (MFEL) and anaerobic threshold (LAN) (DENADAI,1999; CAPUTO et al., 2001). In recent decades, anaerobic threshold (LAN) has been target of many studies of exercise physiology, once it is an extremely interesting reference, better than maximal oxygen consumption (VO_{2Max}) to establish training intensity, to control training effects and to have a performance prediction (SVEDAHL E MACINTOSH, 2003). Many studies have proved that LAN is a good way to estimate MFEL during a race (FIGUEIRA e DENADAI, 2004). The most known methods to identify LAN are lactate threshold (fixed concentration), glucose threshold, ventilatory threshold, heart frequency threshold (ALTIMARI et al., 2007.) and individual anaerobic threshold (FIGUEIRA e DENADAI, 2004). Although, most of those protocols requires expensive and complex tools and procedures, besides being able to evaluate just few athletes (GRECO et al., 2003). According to Popoti et al., (2005), not all the teams have financial support needed to buy sophisticated equipments of evaluation through lactacidemia.

The physiologic meaning of critical power was originally proposed by Monod and Scherrer (1965), as the maximal intensity of muscle work which could be indefinitely maintained without fatigue. The critical power model was suggested by Monod and Scherrer (1965) with the objective of describing the relation between exercise intensity and exhaustion time (NAKAMURA, 2006). Moritani et al., (1981), has given the experimental support to Monod and Scherrer model (1965). Later on, Wakayoshi et al. (1992), used the critical power concept at swimming, calling it critical velocity (Vcrit), even with some changes, using distance-time relation. To find it, it is necessary to build a line of regression (WAKAYOSHI et al., 1992). The critical velocity (Vcrit) is equivalent to an effort borderline intensity that can be maintained with VO_{2MAX} and lactate steady state (SILVA et al., 2006). Pacheco et al., (2006) suggests that tests results which are got in an indirect way from Vcrit can be used in a physical evaluation. Vcrit is an efficient instrument to prescribe and to control the aerobic training by the precise work executed on the reached intensity of meters by seconds (BILLAT et al., 1998).

OBJECTIVE

To determine the time in 500 meters, 1500 meters, 3000 meters and 5000 meters races and check by distance-time relation, if it is possible to find out the critical velocity (Vcrit) among the four distances whose energy system utilization are distinct.

METHODOLOGY

Sample: Seventeen highly trained male runners with experience on short and long races participated in the study (tables 1 and 2). They all read and signed a consent form approved by the University of Itaúna Ethics Committee with protocol number 010/07.

Protocols: They ran 4 different distances on a 200 meters running track. The objective was to identify critical velocity by the linear regression coefficients between times and distances: 1- 500 meters; 2- 1500 meters; 3- 3000 meters; 4- 5000 meters. They ran as fast as possible. The tests were taken at different days of a same week.

Statistical analysis: The data set is expressed with mean and standard deviation (SD). Critical velocity was found by angular coefficient between times and distances. Pearson's correlation test was done to verify correlation among times of the 4 different distances. The significance level used was $p \leq 0,05$.

RESULTS

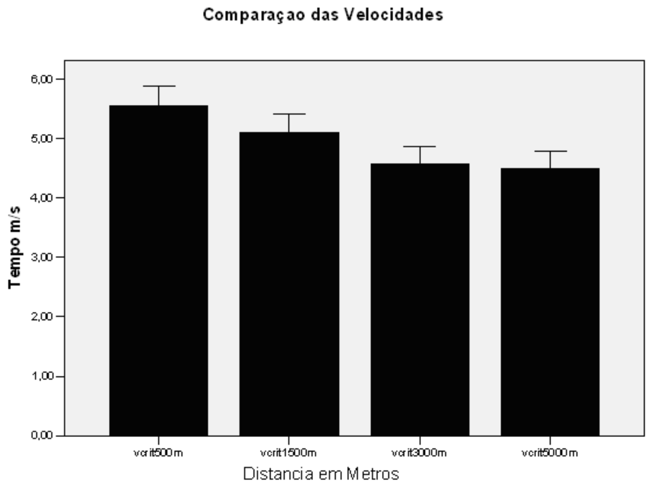
On table 1 we describe information about the runners, as age, body mass, fat percentage.
Table 1 – Anthropometric data.

Group	n	Age (years)	Body Mass (Kg)	Fat Percentage (%)
Runners	17	34,46 ± 10,68	68,28 ± 6,78	12,27% ± 4,97

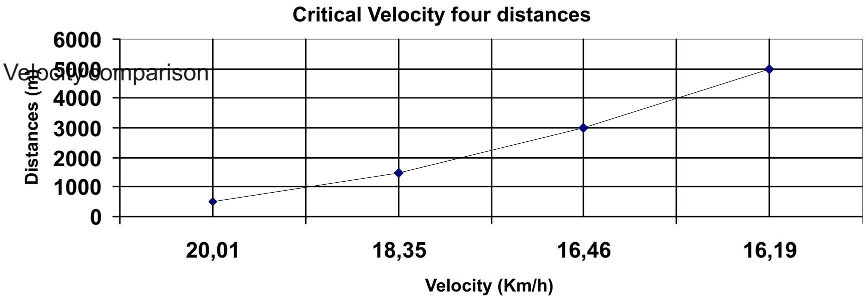
On table 2 we describe information about runners' training, as years, frequency and duration of training session.
Table 2 – Training data.

Group	n	Years of training (years)	Week frequency (days)	Duration of session (minutes)
Runners	17	34,46 ± 10,68	4,70 ± 1,40	82,94 ± 30,97

On graph 1 are the f... ...ion and the covered distance.



Graph 1- Velocity comparison



Graph 1- Critical Velocity

Table 3 – Velocity (Km/h) on covered distances

n	500 m	1500 m	3000 m	5000 m
17	20,01 ± 2,28	18,35 ± 2,14	16,46 ± 2,11	16,19 ± 1,99

On table 3 is showed there was a velocity reduction when the distance was added. Table 4 shows a correlation between the distances 500 m x 3000 m (0,512), 1500 m x 3000 m (0,630), 1500 m x 5000 m (0,696), 3000 m x 5000 m (0,948*). We still demonstrate 500 m distance had a relation only with 3000 m distance. However, all the others got relation among them.

Table 4 – Correlation between the time on distances

Distancia	500 m	1500 m	3000 m	5000 m
500 m	xxxxxxxxxx	0,297	0,512*	0,477
1500 m	0,297	xxxxxxxxxxx	0,630**	0,696**
3000 m	0,512*	0,630**	xxxxxxxxxx	0,948**
5000 m	0,477	0,696**	0,948**	xxxxxxxxxx

* p ≤ 0,05. / ** p ≤ 0,01

DISCUSSION

The search of new indexes capable to predict human performance is extremely interesting, once starting from these, it's possible to prescribe, in a more efficient way, a training program, besides favoring a more precise evaluation to the effects of the training. In that sense, VC tests offer a great correlation with LAn (DENADAI, GRECO E DONEGA, 1997).

Bishop, Jenkins and Howard (1998), and Hughson, Orok and Staudt (1984), recommend 2 tests, at least, to calculate VC. The tests must last a minimum of 2 minutes and a maximum of 20 minutes (BISHOP, JENKINS E HOWARD 1998). Previous studies utilize 2 tests to identify VC. In our opinion, there are few studies (ZAGATTO et al., 2007) which relate more than 2 distances. This argument shows this study importance. Hill (2001) says to determine VC we have to use a 800m minimum distance and compare with 1500 m, or to use 1500 m and compare with 5000 m. Because of this, we can conclude that 500m distance isn't effective to identify VC.

The results confirm the ideas of Bishop, Jenkins and Howard (1998), and Hughson, Orok and Staudt (1984), once the tests that lasted between 2 and 20 minutes got a correlation, but the 500m test, that lasted less than two minutes, didn't get a correlation with other distances.

An important aspect on tests to identify VC is the relative contribution of aerobic and anaerobic systems on the studied distances. Even though there are critiques about methods to estimate the contribution of different energy systems during maximal and supramaximal exercise, recent studies have proved that aerobic contribution on 1.500m is higher than 84% (LINDSAY et al., 1996), exceeding 95% on 5.000m (HECK et al., 1985), while on 400 m the anaerobic system contribution is between 70 a 80% (HILL, 2001). Even though the anaerobic contribution on 1.500m isn't too low, aerobic contribution is much higher on studied distances, except for 500m, what can be understood by the no-correlation between this distance and the other ones. As we analyze an aerobic training parameter control, the use of 1500 m, 3000 m and 5000 m distances was efficient to identify VC. Pacheco et al. (2006) show that 3000m velocity can be considered a very good performance predictor and being a little lower than $VO_{2MÁX}$. Once it is a sub maximal parameter, proving that this distance is good to determine VC.

On a race, Kranenburg and Smith (1996) verified, in adults runners, a high correlation with (r = 0,90) between VC from the treadmill and from the track field, and the relation of this parameter anda the 10 Km performance (r = 0,92). 500m distance can be identified, as definition of Hill and Rowell (1996), as an excellent capacity predictor of anaerobic work. On the other hand, superior distances, like the ones from this study, are great to identify VC (DENDADAI et al., 2003; PACHECO et al., 2006).

When we compare velocities from our study with other from different studies, we can see that on 1500m Denadai, Gomides and Greco (2005) find velocities of 14,2 km/h. This value is lower than the one we found, of 18,3 km/h. On 5000m we found a velocity of 16,19 Km/h, little lower than from other studies, between 17,9 and 18,11 Km/h (DENADAI et al., 2003). Midgley, mc Naughton and Carrol (2007) present a threshold velocity of 13,9 Km/h and $VO_{2MÁX}$ of 16,4 Km/h. This study used a different protocol of the one we used, but we can see that threshold velocity and VC are always in a sub maximal point of $VO_{2MÁX}$, as already said Bernard et al., (2000).

We notice, as was expected, a velocity reduction. It was about 8%, 18%, 20% when we compare 500m with 1500, 3000 and 5000 meters, respectively. About the other distances, there was a reduction of 11 and 12% on 3000 e 5000 meters, comparing to 1500 meters. The difference between 3000 and 5000 meters was 2%. These differences can be explained by a higher utilization of energy systems. A bigger participation of aerobic system represents a slower work velocity, as occurs on long distances.

CONCLUSION

We conclude that 3 of the 4 distances analyzed are efficient to determine VC. We can observe with this study that in field tests intended to determine the VC we must take in consideration the energetic ways mobilization. Although, other studies are necessary to find a relation between VC and LAn and to find VC percentage on $VO_{2MÁX}$ velocity.

Keywords: Field Tests, Critical Velocity, Energetic Systems

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ADRESS: Street: Horácio Sales, nº71. São José. Para de Minas. Minas Gerais. BRASIL. CEP: 35660-000. Tel: (37) 3212387/(37) 99171683. e-mail: sandrofs@uit.br

CRITICAL VELOCITY VERIFICATION THROUGH FOUR VELOCITIES OF AMATEURS RUNNERS

ABSTRACT

The search of new indexes capable to predict human performance is extremely interesting, once starting from these, it's possible to prescribe, in a more efficient way, a training program, besides favoring a more precise evaluation to the effects of the training. **Objectives:** To determine the time obtained in the distance of 500 meters, 1500 meters, 3000 meters e 5000 meters, and to verify through the relationship time/distance the possibility to find the critical velocity (Vcrit) between the four distances where the energetic systems utilization are distinct. **Methods:** Were selected to the study seventeen runners, who are experienced for running middle and long distances. The four distances were performed in a track of 200 meters with the aim to identify the critical velocity through the angular coefficient of the straight line of lineal regression between the respective times and distances: 1- 500 meters; 2- 1500 meters; 3- 3000 meters; 4- 5000 meters. **Results:** Were found a correlation between the distances 3 and 4. The critical velocity achieved it was of 20,02 ± 2,28 Km/h, 18,35 ± 2,14 Km/h, 16,46 ± 2,11 Km/h and 16,19 ± 1,99 Km/h, for the distances of 500 m, 1500 m, 3000 m e 5000 m, respectively. **Conclusion:** We can observe with this study that in field tests intended to determine the Vcrit we must take in consideration the energetic ways mobilization.

Keywords: Field Tests, Critical Velocity, Energetic Systems

VÉRIFICATION DE LA VITESSE CRITIQUE EN 4 VITESSES CHEZ DES COUREURS AMATEURS

RÉSUMÉ

La recherche de nouveaux indices capables de prédire la performance physique est extrêmement intéressante, vu qu'à partir de ceux-ci c'est possible de prescrire de façon plus efficace le programme d' entraînement , outre que favoriser l'évaluation plus précise des effets de l'entraînement développé. **Objectif:** Établir le temps obtenu dans la distance de 500 mètres, de 1500 mètres, 3000 mètres 5000 mètres et vérifier par la relation distance temps la possibilité de trouver la vitesse critique (Vcrit) entre les 4 distances où l'utilisation des systèmes énergétiques sont différents .**Méthodologie:** Ont participé de l'étude 17 coureus amateurs experimentés dans la pratique de course de fond et de moyen fond. Ils ont parcouru les 4 distances dans une piste d'athlétisme de 200 mètres avec l'objectif d'identifier la vitesse critique par le coefficient angulaire de la ligne de régression linéaire entre les respectifs temps et distances: 1 - 500 mètres ; 2 - 1500 mètres ; 3 -3000 mètres ; 4 - 500 mètres. **Résultats:** On a trouvé une corrélation entre 3 des 4 distances proposées. Les vitesse atteintes ont été de 20.02 - 2.28 km/h, 18.35 - 2.14 km/h, de 16.46 -2.11 km/h et de 16.19 - 1.99 km/h, pour les distances de 500 m, 1500 m, 3000 m et 500 m, respectivement.

Conclusion: À la fin de cet étude on a constaté l'importance de tenir compte de l'utilisation des systèmes énergétiques dans les essais de champ pour déterminer la Vcrit.

Mots clés: essais de champ, vitesse critique, systèmes énergétiques.

VERIFICACIÓN DE LA VELOCIDAD CRÍTICA A TRAVÉS DE 4 VELOCIDADES EN CORREDORES AMADORES

RESUMEN

La búsqueda de nuevos índices capaces de predecir el desempeño físico es extremamente interesante, unas vez que a partir de estos es posible prescribir de manera mas eficiente los programas de entrenamiento, además de favorecer la evaluación de los efectos del entrenamiento involucrado. **Objetivo:** Establecer el tiempo obtenido en las distancias de 500 metros, 1500 metros, 3000 metros y 5000 metros y verificar a través de la relación distancia tiempo la posibilidad de encontrar la velocidad crítica (Vcrit) entre las 4 distancias en que la utilización de los sistemas energéticos son distintos. **Metodología:** Participaran del estudio 17 corredores con experiencia en la practica de la corrida de fondo y medio-fundo. Las 4 distancias fueron hechas en una pista de atletismo de 200 metros con el objetivo de identificar la velocidad crítica a través del coeficiente angular de la reta de regresión linear entre los respectivos tiempos y distancias: 1- 500 metros; 2- 1500 metros; 3- 3000 metros; 4- 5000 metros. **Resultados:** Fue encontrada una correlación linear entre 3 de las 4 distancias propuestas. La velocidad lograda fue de 20,02 ± 2,28 Km/h, 18,35 ± 2,14 Km/h, 16,46 ± 2,11 Km/h e 16,19 ± 1,99 Km/h, para las distancias de 500 m, 1500 m, 3000 m e 5000 m, respectivamente. Conclusión: El que observamos con el estudio que testes de campo para determinar la Vcrit deben llevar en consideración la utilización de las vías energéticas.

Palabras Claves: Testes de Campo, velocidad Crítica, Sistemas Energéticos.

VERIFICAÇÃO DA VELOCIDADE CRITICA ATRAVÉS DE 4 VELOCIDADES EM CORREDORES AMADORES

Resumo

A busca de novos índices capazes de predizer o desempenho físico é extremamente interessante, uma vez que a partir destes é possível prescrever de maneira mais eficiente programa de treinamentos, além de favorecer avaliação mais precisa dos efeitos do treinamento desenvolvido. **Objetivo:** Estabelecer o tempo obtido na distancia de 500 metros, 1500 metros, 3000 metros e 5000 metros e verificar através da relação distancia tempo a possibilidade de encontrar a velocidade critica (Vcrit) entre as 4 distancias em que a utilização dos sistemas energéticos são distintos**. Metodologia:** Participaram do estudo 17 corredores com experiência na pratica de corrida de fundo e meio fundo. Foram percorridas 4 distancias em uma pista de atletismo de 200 metros com o objetivo de identificar a velocidade critica através do coeficiente angular da reta de regressão linear entre os respectivos tempos e distancias: 1- 500 metros; 2- 1500 metros; 3- 3000 metros; 4- 5000 metros. **Resultados:** encontramos uma correlação entre 3 das 4 distancias propostas. A velocidade alcançada foi de 20,02 ± 2,28 Km/h, 18,35 ± 2,14 Km/h, 16,46 ± 2,11 Km/h e 16,19 ± 1,99 Km/h, para as distancias de 500 m, 1500 m, 3000 m e 5000 m, respectivamente. **Conclusão:** O que podemos observar com o estudo que testes de campo para determinar a Vcrit devem levar em consideração a utilização das vias energéticas.

Palavras Chaves: Testes de Campo, Velocidade Crítica, Sistemas Energéticos.