



Disponible en ligne sur

**ScienceDirect**  
www.sciencedirect.com

Elsevier Masson France

**EM|consulte**  
www.em-consulte.com



ORIGINAL ARTICLE

# Predicting time to exhaustion during high-intensity exercise using rating of perceived exertion



*Prédiction du temps à l'épuisement pendant un exercice à haute intensité à partir de la perception de l'effort*

N.M. Okuno<sup>a</sup>, L.F. Soares-Caldeira<sup>b</sup>, V.F. Milanez<sup>c,d,\*</sup>,  
L.A.B. Perandini<sup>d</sup>

<sup>a</sup> Department of Physical Education, Universidade Estadual de Ponta Grossa, Av. General-Carlos-Cavalcanti, 4748 - Campus Uvaranas, Ponta Grossa, 84030-900 PR, Brazil

<sup>b</sup> Department of Physical Education, Universidade do Norte do Paraná, PR, Brazil

<sup>c</sup> Department of Physical Education, Universidade do Oeste Paulista (Unoeste), SP, Brazil

<sup>d</sup> Department of Physical Education, Universidade Estadual de Londrina, PR, Brazil

Received 13 January 2015; accepted 5 May 2015

Available online 6 June 2015

## KEYWORDS

Perceptual responses;  
Exercise performance;  
Linear regression;  
Cycling

## Summary

**Objectives.** – This study aimed to predict the time to exhaustion (Tlim) at different high-intensity exercises using a linear regression between 14–17 points of Borg scale and their respective time, verify the agreement and compare them to the real Tlim.

**Methods.** – Nineteen healthy male subjects undertook four constant-load exhaustive exercise bouts on cycle ergometer. These tests were performed on different days and with four different intensities. The power output imposed in each test was determined based on familiarization trials in order to induce a subjects' exhaustion between 2 and 15 min. They were also asked to report the rating of perceived exertion (RPE) during these constant-load exercise bouts. The first value was freely chosen as soon as the subject felt able to accurately report RPE levels, the number corresponding to the verbal anchor on the Borg scale, within of first minute of exercise. Thereafter, whenever they felt that the RPE was increased, the value was recorded. A linear regression was fitted plotting the 14–17 RPE range as a function of time of each test. The Tlim was estimated by extrapolation of the linear relationship to the RPE 19 (Tlim19) and 20 (Tlim20).

\* Corresponding author. Department of Physical Education, Universidade do Oeste Paulista, Campus II, Bloco B3, 19067-175, Presidente Prudente, SP, Brazil.

E-mail address: [viniciunesp@yahoo.com.br](mailto:viniciunesp@yahoo.com.br) (V.F. Milanez).

**MOTS CLÉS**

Réponse perceptive ;  
Performance ;  
Régression linéaire ;  
Cyclisme

**Results.** – The measured Tlim values were significantly higher at the Tlim19 at  $230 \pm 33$  W,  $256 \pm 33$  W and  $289 \pm 36$  W ( $P < 0.01$ ). However, when compared with Tlim20, there were not significant differences in intensity ( $P > 0.05$ ). Furthermore, the intraclass correlation coefficients were all strong (ICC = 0.79–0.87). The RPE at same percentages of Tlim (25, 50, 75 and 100%) during the four constant-load exercise bouts were not different ( $P > 0.05$ ).

**Conclusion.** – Tlim during high-intensity exercises can be accurately predicted by the use of RPE values in the 14–17 range assuming that exhaustion occurs at RPE = 20.

© 2015 Elsevier Masson SAS. All rights reserved.

**Résumé**

**Objectifs.** – Cette étude avait comme objectif de prédire le temps d'épuisement (Tlim) dans différents exercices à intensité élevée en utilisant une régression linéaire entre les points 14–17 de l'échelle de Borg et ses temps respectifs, de vérifier la concordance et de les comparer avec le Tlim réel.

**Méthodes.** – Dix-neuf individus en bonne santé de sexe masculin ont exécuté quatre tests de charge constante exhaustifs sur bicyclette ergométrique. Les exercices ont été réalisés lors de journées différentes et à quatre niveaux d'intensité différents. La puissance imposée à chaque session a été déterminée sur la base de tests de familiarisation, dans le but d'amener les sujets à l'épuisement entre 2 et 15 minutes. Il était demandé aux sujets de fournir une valeur de la perception de l'effort (RPE) pendant l'exercice. La première valeur était choisie librement dès que le sujet se sentait capable d'indiquer correctement les niveaux RPE, en correspondance avec les descriptifs verbaux de l'échelle de Borg, mais dès la première minute de l'exercice. Quand le sujet sentait que la RPE avait augmenté par rapport à cette référence, une nouvelle valeur était alors enregistrée. Une régression linéaire a été ajustée traçant l'amplitude de la RPE 14–17 en fonction du temps de chaque test. Le Tlim a été estimé par extrapolation de la relation linéaire à RPE 19 (Tlim19) et 20 (Tlim20).

**Résultats.** – Les valeurs mesurées du Tlim étaient significativement plus élevées que celles prédites à Tlim19 à  $230 \pm 33$  W,  $256 \pm 33$  W et  $289 \pm 36$  W ( $p < 0,01$ ). Cependant, en comparaison au Tlim20, elles n'étaient pas significativement différentes quelle que soit l'intensité ( $p > 0,05$ ). Par ailleurs, les coefficients de corrélation intraclasse ont été tous forts (ICC = 0,79–0,87). Les valeurs de RPE exprimées en pourcentage de Tlim (25, 50, 75 et 100%) n'étaient pas significativement différentes quel que soit l'exercice ( $p > 0,05$ ).

**Conclusion.** – Le Tlim pendant des exercices à intensité élevée peut être prédit précisément à travers l'utilisation des valeurs de la RPE 14–17 si l'on considère que l'épuisement est atteint à RPE = 20.

© 2015 Elsevier Masson SAS. Tous droits réservés.

**1. Introduction**

The rating of perceived exertion (RPE) is defined as the effort expended while performing a physical task resulting from motor to sensory cortex neural outflow [1] and it has been quantified by means of numerical/verbal scales (e.g. 15-point Borg scale) [2]. Besides being highly correlated with physiological variables (i.e. blood lactate, heart rate, oxygen uptake) [2–4], RPE has shown to be a useful tool to prescribe exercise intensity in the estimation-production paradigm [4,5]. Furthermore, linear regression of submaximal RPE values vs exercise intensity (e.g., 9–17 RPE of 15-point Borg Scale) can be used to accurately predict maximal oxygen uptake ( $VO_2\max$ ) [4,5], preventing the need of maximal efforts.

In constant-load exercise bouts, the RPE increases linearly over the exercise duration [6,7]. Furthermore, when the RPE increase is expressed as a percentage of total exercise duration until exhaustion, there is an overlapping of the regression lines resulting from exercise bouts of different durations [8,9]. Hence, one can expect that exercise

duration until exhaustion be predicted by submaximal RPE values [8,10,11]. However, in incremental exercise the accuracy of the prediction of  $VO_2\max$  can be better when extrapolating the submaximal RPE ( $RPE \leq 17$ ) to RPE19 in comparison to RPE20 [5,12]. It may be suggested that the predictions are better when RPE = 19 is used, since previous researches have already shown that an RPE = 19 is more commonly reported as the feeling of exhaustion/maximal functional capacity [9,13].

Despite some evidence of  $VO_2\max$  prediction from submaximal RPE regression analysis [4,5] and the scalar linear relationship between RPE and time to exhaustion [11]; to our knowledge, there are no studies testing whether time to exhaustion (Tlim) could be accurately estimated by submaximal RPE linear regression during high intensity constant-load exercise bouts and if it is better to extrapolate to RPE19 (Tlim19) or RPE20 to predict Tlim (Tlim20). Tlim prediction with submaximal parameters is an important tool to monitor the physical fitness of different populations and the effectiveness of physical exercise training without inducing exhaustion in an individual. Thus, the purposes of

Download English Version:

<https://daneshyari.com/en/article/4092591>

Download Persian Version:

<https://daneshyari.com/article/4092591>

[Daneshyari.com](https://daneshyari.com)