

## A COMPARISON BETWEEN THE VISUAL ANALOGUE AND BORG'S CR10 SCALES FOR PERCEIVED EXERTION

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### Abstract

*The aim of this study was to determine if the visual analogue and Borg's CR10 scales are efficient for the assessment of perceived general exertion in a ramp continuous dynamic physical exercise test (RCDPET). The sample was composed of 20 sedentary healthy male volunteers (18-29 years). The RCDPET was carried out using an electrically braked cycloergometer (60 rpm), and the scales were asked at the end of each stage. Linear correlations were found between the scales, between the scales and oxygen uptake and also between the scales and heart rate values. These results suggest that the physical magnitudes of VAS and Borg's CR10 scales are highly correlated. Moreover, in both scales, the increase of power, heart rate and oxygen uptake corresponded to the increase of the participants' subjective estimations in relation to the physical effort. This may indicate a clear interaction between the different variables acting during the RCDPET.*

The concept of perceived exertion was introduced at the end of the 1950s by Gunnar Borg and Hans Dahlström (Noble & Robertson, 1996; Borg, 1998). A great number of papers have been published in the last decade concerned with the relations between physical activity, perceived exertion and physiological variables such as oxygen uptake, heart rate, ventilation and blood lactate (Neely et al., 1992; Noble & Robertson, 1996; Borg, 1998; Borg & Kaijser 2005). However, the measurement of physiological variables is very cumbersome, requires specialized equipments and the cost is very expensive which makes it impractical for most applied situation. In research, rehabilitation and sports is important to have a reliable measure in order to be able to plan and evaluate an exercise program. Thus, in order to comprehend the perceived exertion, it is important to understand how different internal and external factors for determination of the optimal level of exercise intensity (Wasserman et al., 1999). Considering these observations, the aim of this study was to determine if the visual analogue and Borg's CR10 scales are efficient for the assessment of perceived general exertion in a ramp continuous dynamic physical exercise test (RCDPET).

### Method

The study was performed on twenty healthy male university students (age 22,5 ± 2,5 years), sedentary and presenting compatible spirometric values with normality. All of them were in good health based on clinical and physical examination and by laboratory tests that included a standard electrocardiogram (ECG), maximum exercise test, total blood count, urinalysis, and clinical biochemical screening tests (glucose, uric acid, total cholesterol and fractions (LDL, HDL and VLDL and triglycerides). The participants were informed about the

experimental protocols and their objectives and signed a formal consent form as required by the local Ethics Committee who approved the study.

All participants were instructed not to take part in any sporting activities 48 h before the test, not to eat 3 h before the test and not to drink coffee 2 h before the test. It was ascertained whether the test person had followed the instruction concerning physical activity, food and beverages before coming to the laboratory.

The experiment was carried out in a climatically room at 22°C, 60% humidity and air pressure 705 mmhg. The participants were studied during a dynamic exercise test in the seated position on a calibrated cycloergometer using continuo protocol. An electrically braked cycloergometer equipped with a microprocessor (model Corival 400, Qinton, Seattle, WA, USA) facilitated the precise application of individualized power values.

Respiratory gas analysis and volume measurements were analyzed using a “breath-by-breath” system (CPX/D Cardiopulmonary Exercise System, Medical Graphics, Minneapolis, MN, USA) which employed a low resistance pneumotach and a Pitot tube flow meter. The system was calibrated before testing each subject using a 3-L syringe for flow volume across a wide range of flow rates and known gases for the CO<sub>2</sub> and O<sub>2</sub> analyzers.

The ECG and HR were obtained from a channel heart monitor (ECAFIX TC500, ECAFIX Ind. E Com. Ltda., São Paulo, SP, Brazil) and processed using an analog-digital. The exertion was assessed using Borg’s CR10 and Visual Analogue Scales. The experimental protocol consisted of each subject underwent two scales with exercise test.

Borg’s CR10 scale is a category scale with ratio properties that permits ratio comparisons to be done between intensities as well as determinations of direct intensity levels. The visual analogue scale (VAS) consisted of a horizontal line on a paper which is presented to the participants, who is asked to indicate the degree of perceived sensory intensity by putting a mark along the line with a pen. The word *none* (no exertion at all) was placed at the left end of the scale, and *extreme* (maximal exertion) was placed at the right end of the scale. The VAS was scored from 0 to 10 cm, but the subjects were unaware of the numbers.

Before the test, participants were familiarized with the apparatus and measurement procedure. After, an instruction was read to the subjects at the beginning of the experiment and the scales were visible to the subjects throughout the whole work test.

Participants worked at an electrically braked cycloergometer and were instructed to keep a pedaling rate of 60 rpm. The ramp continuous dynamic physical exercise test consisted of a 3-min warm-up period at 4 W followed by a continuous power increase set at a value of 25 W/min up to physical exhaustion. The participants were instructed to continue pedaling as long as they possibly could. During the last 10 s of each workload, two scales (CR10 and VAS) were used at each time point. The scales were made available on a A4 sized sheet of paper every time a rating was asked for and the presentations were alternated, first (VAS and CR10) and after (CR10 and VAS).

The data were analyzed using SPSS Statistical Software version 16.0 (SPSS Inc. Chicago, IL). Parametric statistic was used by ANOVA, t-Student test and Pearson correlation, with the level significance set at 5%, and also, psychophysics analysis.

## Results and Discussion

All the participants completed the nine steps. The increase in ratings of perceived exertion is shown in Figure 1. In both scales, the increase of workload, heart rate and oxygen uptake corresponded to the increase of the subjective estimations in relation to the physical effort. Moreover, the increase in perceived exertion in CR10 and VAS ratings followed slightly positively accelerating functions. No significant difference were observed

between CR10 and VAS ratings [ $F(9,30)=0.89$ ,  $p>0.05$ ]. For both scales, power functions were used to describe the  $S-R$  functions. For the CR10 scale, the mean exponent was 1.62 ( $R^2=0.98$ ) and the VAS was 1.49 ( $R^2=0.99$ ). A  $t$ -test showed that the difference observed between exponents obtained with the CR10 and the VAS scales was not significant [ $t(19)=-0.767$ ,  $p=0.453$ ]. The exponents in this study are similar to that previously found by Borg (1998) and Borg e Kaijser (2005).

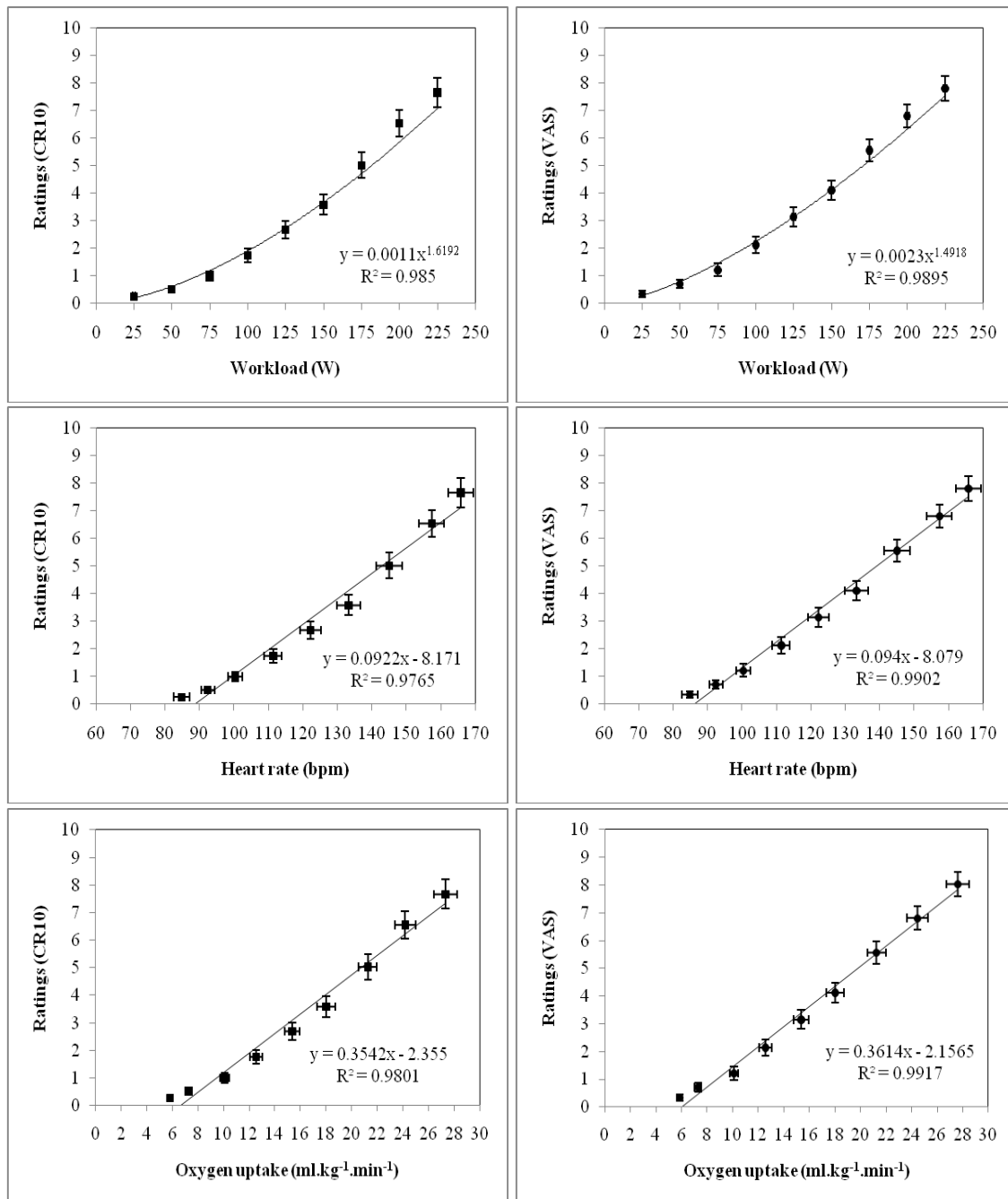


Figure 1. Top panels, Means±SE of CR10 and VAS (cm) plotted against workload (W) values. Middle panels, Means±SE of CR10 and VAS (cm) plotted against Means±SE of Heart Rate (bpm). Bottom panels, Means±SE of CR10 and VAS (cm) plotted against Means±SE of Oxygen Uptake (ml.kg<sup>-1</sup>.min<sup>-1</sup>). Left panels: CR10; Right panels: VAS

In Table 1 is shown the correlation coefficients between ratings (CR10 and VAS scales) and the physiological measure. The correlations between both the CR10 ratings and the VAS ratings and heart rate, and also oxygen uptake, were high and significant. The CR10 scale significantly correlates with VAS, which is already universally accepted for assessment. Similarly to Neely et al., (1992) and Borg (1998), our results showed there was high and significant correlation between these variables.

Table 1. Correlations\* between ratings of perceived exertion for CR10 and VAS scales, oxygen uptake (VO<sub>2</sub>) and heart rate (HR)

|      | VO <sub>2</sub> | HR   | CR10 |
|------|-----------------|------|------|
| CR10 | 0.90            | 0.89 | 1    |
| VAS  | 0.90            | 0.91 | 0.97 |

\*p<0.05

In summary, our findings showed that the physical magnitudes of VAS and Borg's CR10 scales were highly correlated. In both scales, the increase in power, heart rate and oxygen uptake corresponded to the increase in the subjects subjective estimations in relation to the physical effort. These findings suggest a clear interaction between the different variables and both scales were appropriate to the assessment of the general perceived exertion in a continuous dynamic physical exercise test.

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### References

- Borg, E., & Kaijser, L. (2005). A comparison between three rating scales for perceived exertion and two different work tests. *Scandinavian Journal of Medicine & Science in Sports*, 1-13.
- Borg, G. (1998). *Borg's Perceived Exertion and Pain Scales*. Champaign, Illinois: Human Kinetics.
- Neely, G., Ljunggren, G., Sylvén, C., & Borg, G. (1992). Comparison between the Visual Analogue Scale (VAS) and the Category Ratio Scale (CR-10) for the evaluation of leg exertion. *International Journal of Sports Medicine*, 13, 133-136.
- Noble, B.J., & Robertson, R. (1996). *Perceived exertion*. Champaign, Illinois: Human Kinetics.
- Wasserman, K., Hansen, J.E., Sue, D.Y., Whipp, B.J., & Casaburi, R. (1999). *Principles of exercise testing and interpretation* (3<sup>rd</sup> edition). Philadelphia: Lippincott Williams and Wilkins.