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Conference abstract

A short self-paced submaximal test to monitor endurance cycling fitness

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1. Introduction

Monitoring the cyclists' responses to training is important for optimizing training and improving cycling performance (Galán-Rioja, Gonzalez-Ravé, González-Mohíno, & Seiler, 2023; Jeffries et al., 2021). However, this process can be costly and time-consuming. Submaximal fitness tests provide a practical alternative to traditional maximal tests, allowing the monitoring of training effects while minimizing disruptions to the athlete's training and competition schedule (Shushan et al., 2022).

Recently, Sangan, Hopker, Davison, & McLaren (2021) proposed the self-paced submaximal run test (SRT_{RPE}) as a more practical form of the running version of the Lamberts and Lambert submaximal cycling test (LSCT) (Lamberts, Swart, Noakes, & Lambert, 2011). The LCST measures cycling power output (w) or running velocity (v) and ratings of perceived effort (RPE) during two 6-minute stages and one 3-minute stage of increasing intensity, which are determined by a fixed percentage of the maximum heart rate (Lamberts et al., 2011; Vesterinen et al., 2016). In contrast, the SRT_{RPE} monitors v and heart rate (HR_{ex}) during three 3-minute stages prescribed by RPE 10, 13, and 17 (Sangan et al., 2021).

The self-paced nature of the SRT_{RPE} makes it potentially more specific to the pacing demands of competition and, more importantly, less cumbersome since there is no requirement to collect and to store RPE data for later analysis, nor to do a prior maximal testing to establish the relative intensity of each stage. Furthermore, standardizing intensity by RPE could provide a better insight into the individual's responses to endurance training by reflecting more accurately individual differences in the exercise intensity domains (Iannetta et al., 2020; Seip, Snead, Pierce, Stein, & Weltman, 1991). Sangan et al. (2021) reported promising findings showing that v, at all stages of the SRT_{RPE}, was largely correlated with aerobic fitness parameters such as maximal oxygen uptake (VO_{2max}), v at VO_{2max} (vVO_{2max}), and v at lactate threshold 2 (vLT2). Moreover, test retest analysis showed acceptable reliability with coefficients of variation between 2.5% and 5.6% for v and HR_{ex} at all stages (Sangan et al., 2021).

Given the supportive findings and potential benefits of a self-paced design, the aim of our study was to evaluate the feasibility of a cycling-specific adaptation of the SRT$_{RPE}$ protocol. The modified protocol incorporates the latest research on RPE and is tailored towards the specific requirements of road cycling (Ebert, Martin, Stephens, & Withers, 2006; Lopes, Pereira, & Silva, 2022). The self-paced submaximal cycling test (SCT$_{RPE}$) measures w and HR$_{ex}$ responses during three 2-minute stages using Borg's CR100 scale (RPE Moderate, Hard, Very Hard) and evaluates neuromuscular function with one second peak power (w$_{sprint}$) and post-exercise heart rate recovery (HRR).

2. Materials and Methods

Twenty-three trained to highly trained (29.6 ± 9.2 y, 72.7 ± 9.7 kg, VO_{2peak} 65.6 ± 7.1 ml·kg^{-1}·min^{-1}) endurance cyclists (including 3 females) received standardized RPE instructions and anchoring procedures. Then, they underwent the first trial of the SCT$_{RPE}$. They also performed three 6-second maximal sprints and a graded exercise test (GXT) to determine their maximal neuromuscular one second peak power (w$_{MAXsprint}$), ventilatory thresholds (VT1, VT2), peak oxygen consumption (VO_{2peak}), and peak power (w$_{peak}$). Within a period of 2 to 14 days, the participants completed two additional trials of the SCT$_{RPE}$ to evaluate the test-retest reliability of HRR, w$_{sprint}$, HR$_{ex}$, and w at each stage of the test. Correlations were used to examine the relationship between the SCT$_{RPE}$ and the parameters measured during the GXT to establish convergent validity.

3. Results

Power output measured during all stages of the SCT$_{RPE}$ had moderate to very large correlations with the parameters measured during the GXT, ranging from .48-.85. Notably, the highest correlation (r = .85) was observed between w$_{peak}$ and w at RPE Very Hard (Figure 2). The intraclass correlation coefficients ($ICC_{3,1}$) for w and HR$_{ex}$ at all stages of the SCT$_{RPE}$ ranged from .86-.92, indicating high to very high reliability, with typical errors (TEs) ranging from 2.7% to 7.9% (Table 1). The reliability of HRR expressed as a percentage of the peak heart rate recorded during the trial (HRR$_{\%hrpeak}$) and w$_{sprint}$ was found to be moderate and very high, respectively, with $ICC_{3,1}$ value of .74 and .93, and TEs of 4.4% and 6.7% (Table 1).

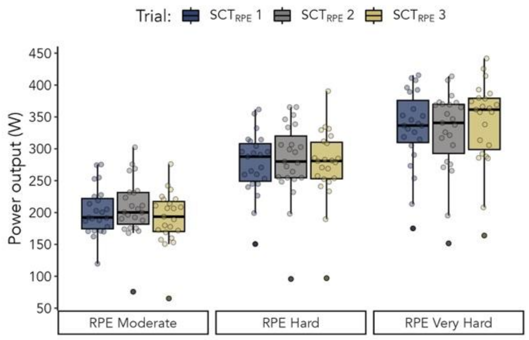

Figure 1. Box plots showing the differences in power output at each stage of the SCT$_{RPE}$ over 3 repeated trials. The box defines the upper and lower quartiles and the median. Whiskers show the minimum and maximum differences. RPE indicates rating of perceived effort; SCT$_{RPE}$, submaximal cycling test.

Table 1. Test-Retest Reliability of the Parameters of the Self-Paced Submaximal Cycling Test, Over 3 Repeated Trials (n = 23).

Parameter	Mean (SD)	TE	CV (%)	ICC
Power output (W)				
RPE Moderate	200.26 (42.13)	15.85	7.91	0.86
RPE Hard	278.3 (54.79)	16.77	6.02	0.91
RPE Very Hard	333.33 (63.33)	21.88	6.57	0.88
Heart rate (beats/min)				
RPE Moderate	139.78 (17.96)	5.8	4.15	0.89
RPE Hard	157.84 (17.99)	5.66	3.59	0.9
RPE Very Hard	171.97 (16.46)	4.66	2.71	0.92
Others				
HRR (beats/min)	46.43 (13.02)	6.63	14.27	0.72
$HRR_{\%hrpeak}$ (%)	27.2 (8.3)	4.35	-	0.74
w_{sprint} (W)	1135.93 (275.31)	76.32	6.72	0.93

Abbreviations: HRR, heart rate recovery; HRR$_{\%hrpeak}$, heart rate recovery expressed as a percentage of the peak heart rate recorded during the trial; w$_{sprint}$, neuromuscular function; TE, Typical error; CV (%), TE expressed as a coefficient of variation; ICC, Intraclass correlation coefficient.

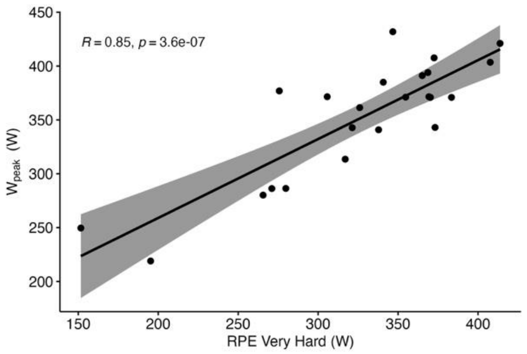

Figure 2. Pearson correlation (r) with 95% confidence interval of power output at RPE Very Hard with W_{peak} from the graded exercise test.

4. Conclusions

The study findings suggest that the SCT_{RPE} is a reliable and valid measure of endurance cycling fitness. The high intraclass correlation coefficients and good convergent validity with the parameters of the GXT, particularly W_{peak}, indicate that the SCT_{RPE} could be an effective and practical test to monitor endurance cycling athletes' responses to training.

5. Practical Applications

Athletes and coaches using the SCT_{RPE} may be able to observe changes in training status when the power output exceeds the TE measured for each stage. For example, if the power output of a cyclist during the last stage (RPE Very Hard) of the SCT_{RPE} exceeds by 25W his power output of the previous test, we can assume that his cycling fitness is rising because the change is greater than the TE of 22W for this stage.

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Conflicts of Interest: The authors declare no conflict of interest.

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