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A simple method for assessing running critical velocity without exhaustion: the Ramp Above Critical Level Endurance Test

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Introduction. Critical intensity is an important fatigue threshold with considerable potential for enhancing performances or quality of life of individuals experiencing chronic diseases [1]. Traditionally, critical velocity (V_c) is assessed from 3 to 5 tests-to-exhaustion, time-trials (TT) or all-out, making regular assessments of athletes or frail populations challenging. Recently, Bowen et al. [2] formalised a mathematical model that describes the evolution of maximal capacities at any time of severe exercises. This model, along with the V_c concept suggests that maximal velocity (V_{max}) decreases when running above V_c and recover for intensity below V_c . Thus, performing a decreasing ramp starting above and finishing below V_c , V_{max} is assumed to decrease and then rise again, the ramp value at switch point corresponding to V_c . Based on this idea, the Ramp Above Critical Level Endurance Test (RACLET) has been validated in cycling [3]. The RACLET consists in a 5-min non-exhaustive test following a decreasing ramp velocity target during which ~ 3 s sprints assess V_{max} every 30s. This study aimed to test the reliability and validity of the RACLET during running.

Methods. 17 participants completed 4 sessions separated by 24h, starting with a 30-min standardised warmup. Session 1 included 2 identical RACLET separated by a 10-min rest, and during which participants running velocity was measured using GPS (GPexe, 18Hz). RACLET started at 65% of the initial maximal velocity (V_i) and gradually decreased to reach 3m/s at 5min. To maintain the target pace, participants followed a pacing bike that shifted to the side during sprints. Sessions 2 to 4 included randomised TT on 400, 1500 and 3000m. V_{max} reached during each sprint of the RACLET or mean velocity performed during the TT allowed to fit the following equation:

$$V_{max}(t) = V_i - \frac{1}{\tau} \int_0^t (V(T) - V_c) dT \quad (1)$$

where V is the target velocity and τ is a time constant. V_c reliability was quantified using SEM and ICC between the 2 RACLET. Validity was assessed using systematic and random errors compared with the gold standard method (TT).

Results. Mean V_c was 13.5 ± 2.1 km/h on RACLET. This value is in line with data reported in the literature [4]. V_c determined with RACLET showed good absolute (SEM=3.7%) and relative (ICC=0.95) reliability and presented a good concurrent validity with low systematic (0.1km/h; 1.3%) and random (0.7km/h; 5.6%) errors. V_c obtained from RACLET and TT were highly correlated ($r=0.95$, $p<0.001$).

Conclusion. The RACLET is a valid and reliable method to assess V_c in running. This test has the advantage of being short, carried out in a single session and mainly submaximal (excluding short V_{max} evaluations). The RACLET is interesting for research purposes to evaluate V_c (e.g. for experimental designs with numerous conditions) but also for follow-up monitoring requiring frequent reassessment of V_c , which was hitherto difficult to do.

References.

- [1] Poole et al., MSSE, 2016
- [2] Bowen et al., JTB, 2023
- [3] Bowen et al., ECSS, 2023
- [4] Kramer et al., EJAP, 2020