A field method to determine critical velocity in manual wheelchair propulsion

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Résumé

Introduction.
To maintain or repeat a required velocity is crucial in sporting and daily efforts. This ability can be characterized by the critical velocity (vc), which delimits exhausting from recovery efforts. This boundary can be estimated from tests-to-exhaustion, time-trials or all-out efforts, which are cumbersome methods due to strenuous efforts or plural days of measurement. Recently, the "Ramp Above Critical Level Endurance Test" (RACLET) was developed as a quick and less fatiguing method to assess vc (Vonderscher et al., 2024). Unfortunately, the protocol does not fit to wheelchair users' typical training environment constraints as, with limited dimensions, indoor gyms impose pronounced velocity fluctuations due to back-and-forth shuttle. This work aimed at evaluating validity and reliability of an original indoor field test to asses vc in manual wheelchair propulsion (MWP).

Methods.

Able-bodied individuals (n=8) with various experiences in MWP participated to a single session. Starting with 20-min warm-up, they then performed 2 RACLET and a 3-min all-out test, separated each by 15-min rest. Wheelchair velocity was measured with inertial measurement units (128 Hz; WheelPerf System, AtoutNovation, France). RACLET was performed indoor along a 45-m straight line, including 180◦ turns at each end, and consisted of eight 10-s sprints interspaced with seven 30-s constant submaximal velocity exercises, self-monitored with a bike computer. During RACLET, submaximal velocity decreased from 70% maximal velocity to 4 km/h. The all-out test was performed on an "8-form-octagon" track, validated to assess wheelchair users' physical fitness, including inexperienced ones (Weissland et al., 2015). Determination of vc was based on maximal sprinting velocity changes with cumulated distance above and below vc during RACLET, and corresponded to 30-sec end velocity of the all-out test. Reliability of vc determined with RACLET was quantified with SEM and ICC, and its validity assessed via systematic and random errors compared to the 3-min all-out test. Sensitivity of vc was assessed with minimal detectable change (MDC).

Results.

Mean vc of the first RACLET (7.29±0.69km/h) was not different from values of the second one (7.26±0.57km/h; p=0.785). Absolute (SEM=3.1%) and relative reliability (ICC=0.88) of vc resulted in MDC=0.58km/h. Determined with the 3-min all-out test, vc had +0.54km/h

*Intervenant

systematic, 0.51km/h random errors, and was different from vc obtained with RACLET (p=0.017), but both were correlated (r=0.95; p< 0.001).

Discussion.

As a first-time assessment, the order of magnitude of vc cannot found a direct point of comparison in the scientific literature. Yet, values are in line with velocity reported during MWP world records of the greatest distance covered during 12-h (_˜6.4km/h) and 24-h contests (_˜7.6km/h) by non-able-bodied athletes. The almost excellent reliability highlights quantification of vc with small errors of measurements, and this, across participants with broad experience in wheelchair. The resulting MDC would be enough small to detect change due to (de)training in well-trained athlete or nutritional intakes (Galán-Rioja et al., 2023). The systematic difference could be due to a slight wheelchair velocity decrease (yet below vc) during 8-form track's turns, but enough to elicit recovery, which increased velocity in subsequent straight lines, and, in total, led to higher mean velocity over the test, including during the last 30s.

Conclusions/Perspectives.

The proposed adaptation of RACLET to wheelchair displayed an encouraging feasibility and applicability on the field, through good metrology qualities, minimal equipment required, and free from wheelchair steering experience level. Though usage of inertial measurement units requires specific skills, wheelchair velocity during RACLET could be measure with a chronometer or timing system at strategic moments. RACLET represents a promising quick, reliable and valid evaluation to assess endurance of wheelchair users for training follow-up. Also, low fatigue level developed during the test ease addition to routine assessments.

References.

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