VALIDITY AND RELIABILITY OF A NOVEL METHOD FOR MEASURING MAXIMAL POWER OUTPUT DURING 6-s ALL-OUT SINGLE LEGGED ACTIONS ON A FRICTIONALLY-BRAKED CYCLE-ERGOMETER

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Measurement of maximal power output (Pmax) during an all-out sprint action lasting a few seconds on a frictionally-braked cycle-ergometer commonly requires instrumenting the cycle's flywheel (Arsac et al, 1996). This study proposes using a novel method for measuring instantaneous Pmax by measuring the flywheel's angular velocity and acceleration through motion analysis (MA). Hence, the purpose of this study is to demonstrate the validity and reliability of using MA against a direct measure of Pmax by means of force transducers (FT) incorporated in a standard pedal. A single leg model is proposed for its applicability to experimental research.

With Ethics Committee approval, 8 women (age 23.1±3.4 yrs; stature 1.65±0.06 m; body mass 60.4±5.0 kg; mean±SD) and 8 men (age 28.5±5.2 yrs; stature 1.78±0.04 m; body mass 77.0±11.5 kg), recreationally active, took part in 3 identical sessions, separated by 4-6 days, the first being a familiarisation. During each session testing initially involved determining the participants maximal friction-load turned through two complete pedal revolutions (2-RM; Macaluso et al, 2003). Individuals then performed three 6-s sprints against two different loads, 20% and 50% 2RM, with 3-min rest between trials. All trials were performed using the right leg, while the left leg rested on the bike. Position data of the reflective markers placed on the flywheel, side of the pedal and crank centre were collected using a five camera system (Vicon M2, California, USA) at 250Hz. The flywheel's acceleration was obtained as double derivative and filtering of kinematic data, transposed from cartesian to polar coordinates, and torque as the sum of the inertial component, angular momentum and friction resistance applied to the flywheel.

Technical description of the instrumented pedal has been previously reported (Bibbo et al, 2006). The pedal torque was obtained using force data and crank length. In both cases power was calculated as the product of torque and angular velocity. Pmax was obtained in both systems from the average of the 3 highest peaks in each trial.

Validity: MA recorded significantly higher Pmax than FT ($P<0.05$) on average by 40.9±18.9 W in men and 12.9±6.9 W in women. However, Pmax recorded with the two systems was highly correlated (Pearson's correlation coefficient 0.85±0.04 in men and 0.98±0.02 in women). Repeatability: average intraclass correlation coefficients of 0.90±0.05 in males and 0.85±0.08 in females indicate a very high degree of repeatability between trials and days for both systems.

The novel method of using MA to measure Pmax on a cycle-ergometer has been proven as a valid a reliable method for use in exercise physiology research provided a consistent bias between the measurements is allowed for.

References

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