FATIGUE AFTER WINGATE TESTS OF DIFFERENT DURATION

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INTRODUCTION: A comparison among 60 seconds of maximal hopping, drop-jumping, and cycling showed the presence of high-frequency fatigue after hopping and drop-jumping and low-frequency fatigue after cycling (Jereb & Strojnik, 1995). It was assumed that a shorter duration of maximal cycling may also produce high-frequency fatigue.

METHODS: Nine students of physical education (age 23.4 ± 2.7 years, height 176.9 ± 3.3 cm, mass 70.4 ± 4.9 kg) gave their formal consent and volunteered for the study. They were acquainted with all the measuring protocols. Three Wingate tests were performed: 15 s, 30 s and 45 s test. Fatigue index as a drop in power during cycling (Bar-Or, 1987), blood lactate concentration and tetanus forces at 20 and 100 Hz electrical stimulation for the vastus lateralis muscle were measured. Before all tests and measurements, the subjects warmed-up with the standardized protocol. Electrical stimulation measurements were obtained four minutes before and one minute after the workout. Two transcutaneous stimulation electrodes (Axelgaard, Falbrook, CA) were placed over the distal and middle parts of VL of the right leg (Fig. 1). The amplitude of stimulation was three times the motor threshold of the subject, which was established by 0.8 s long trains of electrical impulses delivered at 100 Hz. The amplitude was held constant during both tests. The same

Figure 1. Position of subject before measurement.

train duration was employed during the measurements of isometric knee torque of relaxed muscle stimulated at 20Hz and 100 Hz. During the electrical stimulation, the isometric knee torque was measured. The subjects lay on their backs with fastened hips and supported lumbar spine to prevent pelvic movements. The right leg was mounted into a measurement frame at 45 degrees knee angle (Fig. 1). For the stimulation, a custom-made electrical stimulation device was employed. Blood samples were taken from a finger tip four minutes before and five minutes after the workout. The statistical significance of differences between pre- and post-workout measurements were tested with the two-way student test for paired samples. Post-workout results were normalized to the pre-workout ones.

RESULTS: Fatigue indexes decreased for 15.5%, 35.77%, and 51.27% respectively. Blood lactate concentrations were significantly increased after all tests and reached 6.7 ± 0.8 mmol/l, 12.5 ± 1.1 mmol/l, and 12.8 ± 1.7 mmol/l for 15 s, 30 s, and 45 s test, respectively (Fig. 2).

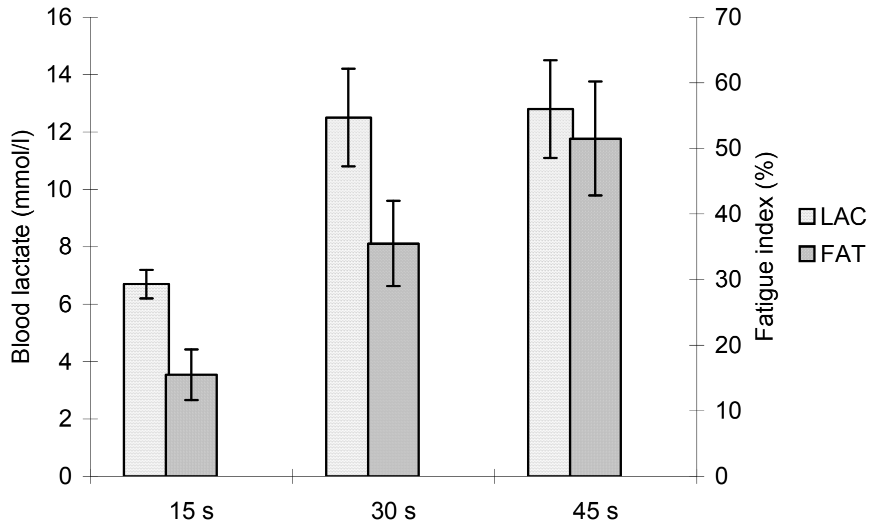

Figure 2. Maximum blood lactate accumulation (LAC) and fatigue index (FAT).

Blood lactate concentrations corresponded well to fatigue indexes, since the highest lactate concentration was seen at the greatest fatigue and vice versa. Mean 20 Hz stimulation forces decreased to 81%, 70% and 60% of the pre-workout value after 15 s, 30 s and 45 s, respectively (Fig. 3). At 100 Hz stimulation, the changes and differences among tetanus forces were much smaler. The smallest decrease in 100 Hz force was observed at 30 s test (94% from pre-workout level) and greater decrease at 15 and 45 s test (89% from pre-workout level). The decreases of tetanus forces during 20 Hz and 100 Hz stimulation under the pre-workout level were statistical significant in all tests.

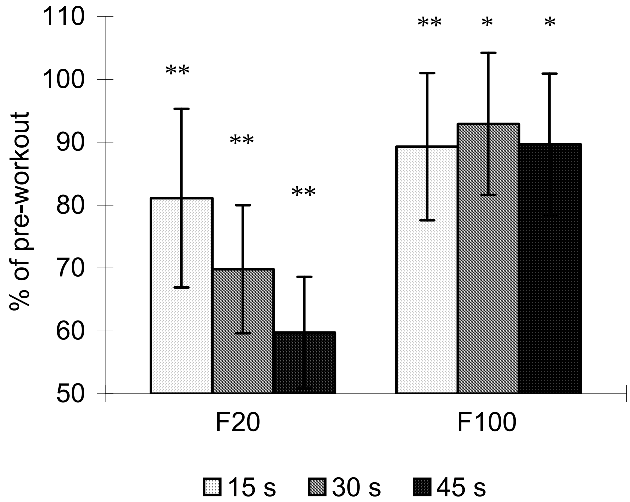

Figure 3. Relative changes in 20 Hz (F20) and 100 Hz (F100) stimulation force after workouts (100% is pre-workout level). *-P<0.05, **-P<0.01 (pre-post T-test).

DISCUSSION: Low-frequency fatigue was dominant after all observed durations of the Wingate test. However, significant differences existed in its magnitude depending on the duration of the test. For practice, this means that the Wingate test is not suitable for high-frequency fatigue assessment. For theory, these results showed that a type of contraction has an important role in the modulation of fatigue appearance. It is possible to assume that during a maximal concentric muscle action low-frequency fatigue will occur predominantly, while a maximal stretch-shortening cycle exercise may lead to high-frequency fatigue.

CONCLUSIONS: Changes in 20 Hz and 100 Hz measured at the three Wingate tests showed low and high frequency fatigue. Low frequency fatigue was much more present and thus indicated that none of the three tests can be used for a high frequency fatigue estimation.

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