TECHNICAL SKILL AFFECTS POWER LOSSES IN ROWING
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INTRODUCTION
Technique is important in rowing. The athlete has to minimize energy loss and maximize power output ($P_{rower}$).
For steady state rowing the power equation is: $P_{rower} = P_{metabolic} \cdot e_{gross} = -(P_{drag} + P_{\Delta v} + P_{blade})$ [2], with $P_{metabolic}$ the metabolic power production and $e_{gross}$ the gross efficiency. $P_{drag}$ and $P_{\Delta v}$ describe power loss to shell drag. $P_{drag}$ is the power loss that occurs if shell velocity would be constant. $P_{\Delta v}$ is the additional power loss resulting from velocity fluctuations. $P_{blade}$ describes power loss at the blades during push off.

We investigated how the execution of the stroke is related to velocity efficiency ($e_{velocity} = 1 - P_{\Delta v}/P_{rower}$ [1]). The study was performed using a rowing ergometer. The ergometer was put on wheels, to allow it to move back and forth. It was coupled to a motor that dissipated power in a velocity-dependent way, similar to $P_{\Delta v}$ in on-water rowing.

The first aim of this study was to determine if the better performing athletes in a group of well-trained rowers have a higher $e_{velocity}$ in addition to the expected higher $\dot{V}O_{2max}$. The second aim was to investigate which kinetic technique variables are related to differences in $e_{velocity}$.

METHODS
22 Well-trained female rowers participated. All performed a 2000m time trial on the modified ergometer. Forces on the handle and foot stretcher ($F_{handle}$ and $F_{stretcher}$) were recorded and $\dot{V}O_{2max}$ was determined; $e_{gross}$ was determined separately. Timing of $F_{handle}$ and $F_{stretcher}$ was described by rower induced impulse fluctuations (RIIF) of the ergometer, which were determined by calculating the time integral of the net force on the ergometer (i.e., $F_{handle} + F_{stretcher}$) for discrete parts of the rowing cycle. A stepwise regression analysis was performed using $\dot{V}O_{2max}$, $e_{velocity}$ and $e_{gross}$ to predict 2000m time. Correlations were established between $e_{velocity}$ and RIIF values.

RESULTS AND DISCUSSION
Total explained variance for 2000m time was 78%; 14% was explained by $e_{velocity}$ ($P<.05$). Significant negative correlations were found between $e_{velocity}$ and RIIF for the complete cycle, for the phases just before and after the catch and for the recovery phase ($P<.01$), meaning that low RIIF will lead to high $e_{velocity}$. When $F_{handle} = -F_{stretcher}$, ergometer acceleration will be zero; RIIF will be zero and $e_{velocity}$ will be 1. Yet, the associated movement pattern is unlikely to allow optimal use of large muscle groups and $P_{rower}$ would be low. The best technique will be a compromise between maximum $P_{rower}$ and maximum $e_{velocity}$.

The timing of forces around the catch is important. High $F_{stretcher}$ not accompanied by similar $F_{handle}$ should be avoided as it will lead to high RIIF. The rower’s C.O.M. velocity during the recovery phase should be kept to a minimum. After the catch the connection from hips to hands should be stiff to ensure an optimal transfer of $F_{stretcher}$ to the handle.

REFERENCES

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