Is there a relationship between isokinetic strength parameters and 4-km cycling performance?

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Introduction

- The cycle stage of an Olympic distance triathlon is characterised by short bouts of high intensity cycling (1), especially during the initial stages, with high power output correlating with overall cycle performance (2).
- Previous research indicates that chronic cycle training may change the muscle mechanics within the leg muscles (3, 4). Considering the triathlete spends time training in both shortened (cycle) and lengthened (run) muscular conditions, adaptations to chronic training may be quite different to pure cyclists; however no studies have used triathletes as participants.
- Studies (5,6) have failed to establish a relationship between strength measures and cycling performance (40 km & 30 km). This could be explained by the differing muscle strength required for the tests, maximal vs endurance.

Purpose

The purpose of this study was to investigate the relationship between isokinetic peak torque of the knee extensors and flexors with 4-km cycling performance of triathletes, and at which angle this peak torque occurred. Additionally, limb asymmetry and hamstring to quadriceps ratio were also assessed.

Methods

- Six male recreational triathletes (age 37.5 ± 10.0 years; height 176 ± 7.2 cm; mass 75.5 ± 13.2 kg) volunteered to participate in the study.
- Participants performed 2 sets of 3 continuous maximal extension / flexion concentric muscular contractions at an angular velocity of 180˚.s^{-1}. Two minutes of rest was given between sets. This was followed by 3 minutes of rest before performing 1 set of 3 maximal repetitions at an angular velocity of 60˚.s^{-1}. The opposite limb was then tested following the same protocol.
- After 15 minutes of passive rest, participants performed a 4-km cycle time trial using their own bicycle mounted to a Cyclus2 ergometer, remaining seated throughout.

Figure 1. Isokinetic strength testing.

Figure 2. 4-km cycle time trial.

Practical Applications

Practically, a triathlete who participates in short-middle distance triathlons may benefit from increasing lower limb strength as it has been shown that higher amounts of lower limb strength is beneficial for fast high-intensity cycling. Therefore, including lower limb resistance training and or hill cycling is recommended. Furthermore, training with slow velocity movements may increase muscle balance at slower velocities, which could decrease the chance of injury and increase performance during high resistance cycling such as hill climbing. Monitoring of knee extensor and flexor strength along with regular time trial assessment is recommended to ensure training protocols are improving strength and performance.

References

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Results

Table 1. Correlational coefficients (Pearson's *r*), and descriptors between cycle peak power, average power, isokinetic strength and cycle time.

	Correlations with Cycle Time	
Variable	r value	Descriptor
Cycle peak power	-0.32	Moderate
Cycle average power	-0.99	Nearly Perfect
60˚.s^{-1} extensor dominant	-0.85	Very Large
60˚.s^{-1} extensor non-dominant	-0.78	Very Large
60˚.s^{-1} flexor dominant	-0.63	Large
60˚.s^{-1} flexor non-dominant	-0.78	Very Large

Table 2. Strength differences between dominant and non-dominant limbs.

	Dominant vs Non-dominant	
Limb Asymmetry	Raw difference (Nm)	% difference
Extensors @ 180˚.s^{-1}	11.2	8
Extensors @ 60˚.s^{-1}	16.7	10
Flexors @ 180˚.s^{-1}	10.3	10
Flexors @ 60˚.s^{-1}	14.5	17

Table 3. Mean ± SD (*n* = 6) for the hamstring to quadriceps torque ratio.

H:Q Torque Ratio	Mean ± SD
180˚.s^{-1} dominant	0.70 ± 0.13
180˚.s^{-1} non-dominant	0.81 ± 0.14
60˚.s^{-1} dominant	0.51 ± 0.12
60˚.s^{-1} non-dominant	0.54 ± 0.05

Findings / Discussion

- Correlational results are shown in Table 1, with limb asymmetry and H:Q ratios presented in Tables 2 and 3, respectively.
- Results found cycle time was strongly correlated to extensor and flexor peak torque of both dominant and non-dominant limbs at an angular velocity of 60˚.s^{-1}. Although a near perfect correlation was found between cycle time and average cycle power, cycle peak power was only moderately correlated.
- Peak torque for extensors occurred at an angle of 54.3˚ and 20.3˚ for flexors.
- Limb asymmetry was higher for extensors and flexors at an angular velocity of 60˚.s^{-1} compared to 180˚.s^{-1}.
- H:Q ratios show a larger imbalance exists at an angular velocity of 60˚.s^{-1} compared to 180˚.s^{-1}.

Conclusions

- **This study was able to demonstrate a strong relationship between 4-km cycle time and isokinetic peak torque of the knee extensors and flexors of both dominant and non-dominant limbs of triathletes.**
- **Angular velocity influences muscle strength balance, with triathletes showing decreased limb asymmetry and better H:Q ratios at a higher velocity.**