



Does greater muscle strength and size result in greater hamstrings-to-quadriceps ratio?

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BACKGROUND

Hamstrings-to-quadriceps ratio (HTQ) can provide unique information regarding muscle development, training habits, and injury risk, particularly of the knee. Theoretically, males and females who are stronger and thus more strength trained should have greater HTQ, though this has not been well studied.

PURPOSE

The purpose of this study was to compare HTQ for females and males with above and below average thigh strength and muscle size during knee extension and flexion contractions.

METHODS

Twenty-seven females and males (mean±95% confidence interval, n=14 females, age=24±4yrs; n=13 males, age=25±6yrs) participated. Ultrasound images quantified quadriceps, hamstrings, and thigh muscle cross-sectional area (CSA). Peak torque (PT) was taken from maximal voluntary isometric contractions (MVICs) and isokinetic knee extension and flexion contractions from 60-300°·s⁻¹. HTQ was calculated by dividing PT from knee flexion by PT from knee extension for all contractions. Total thigh strength (TTS) was calculated by adding knee extension MVIC PT and knee flexion MVIC PT. Total thigh muscle size (TTMS) was calculated by adding quadriceps CSA and hamstrings CSA. Mixed-factorial ANOVAs examined differences in HTQ for above vs. below average TTS and TTMS males and females.

CONCLUSIONS

Both groups had similar patterns of response for leg extension PT and HTQ across velocity, though leg flexion PT for females remained constant from moderate to fast velocities. Thus, factors other than quadriceps and hamstrings muscle size and strength may be responsible for the potential sex-based difference in knee injury risk. Worth noting, among these recreationally-trained participants, HTQ across velocity was ≤0.59, below the generally recommended ratio of 0.67. It may be beneficial for both females and males to prioritize hamstrings strengthening exercises, as HTQ of <0.67 tend to be associated with greater knee injury risk.

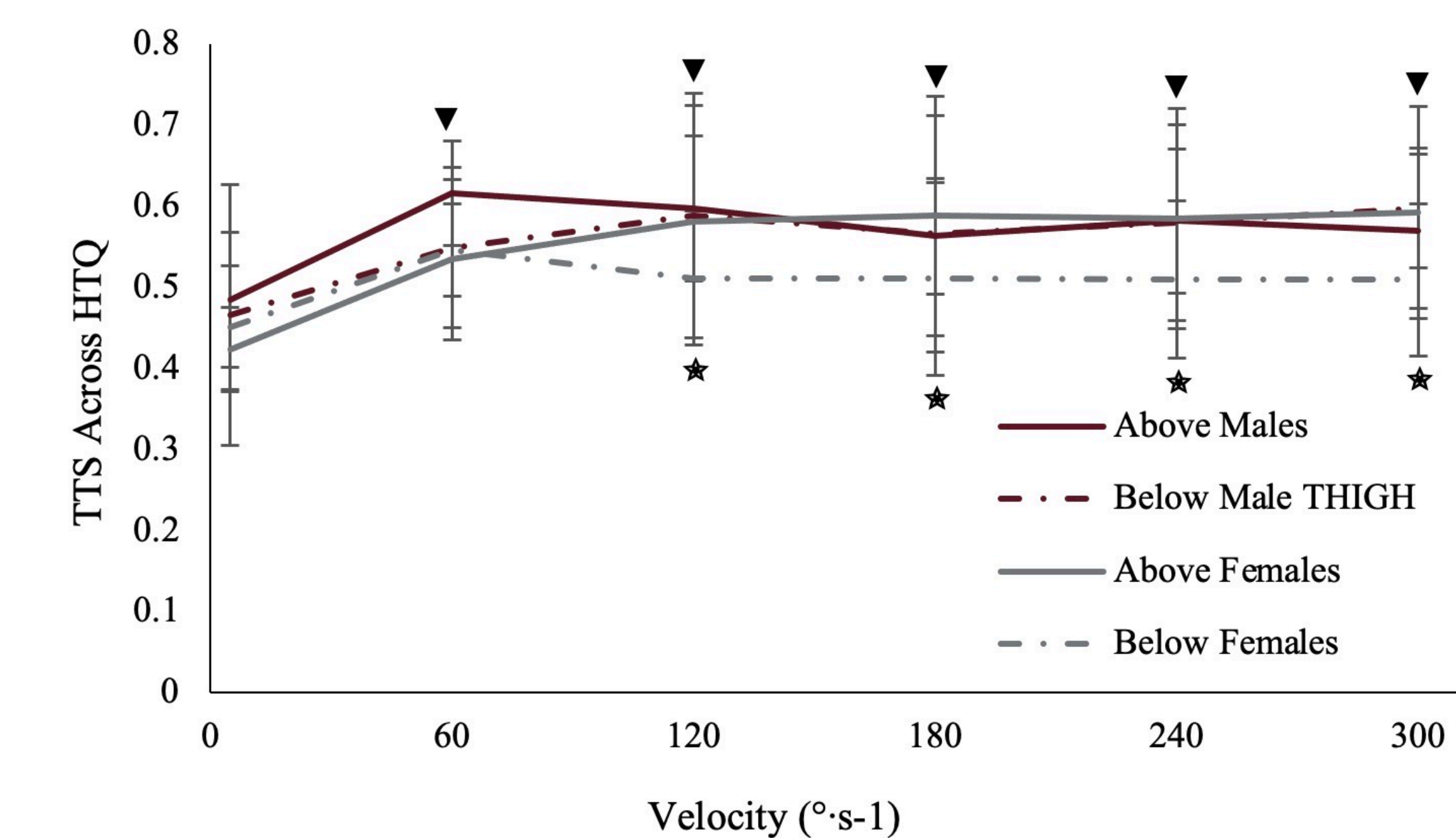
- No sex- or group-based differences in HTQ when split by TTS or TTMS across velocity
- Females with above average TTS had greater HTQ above 60°·s⁻¹
- Males with above average TTS increased HTQ from MVIC to 60°·s⁻¹ and then plateaued
- For all groups in TTMS, HTQ increased from MVIC to 60°·s⁻¹ and then plateaued

PRACTICAL APPLICATIONS

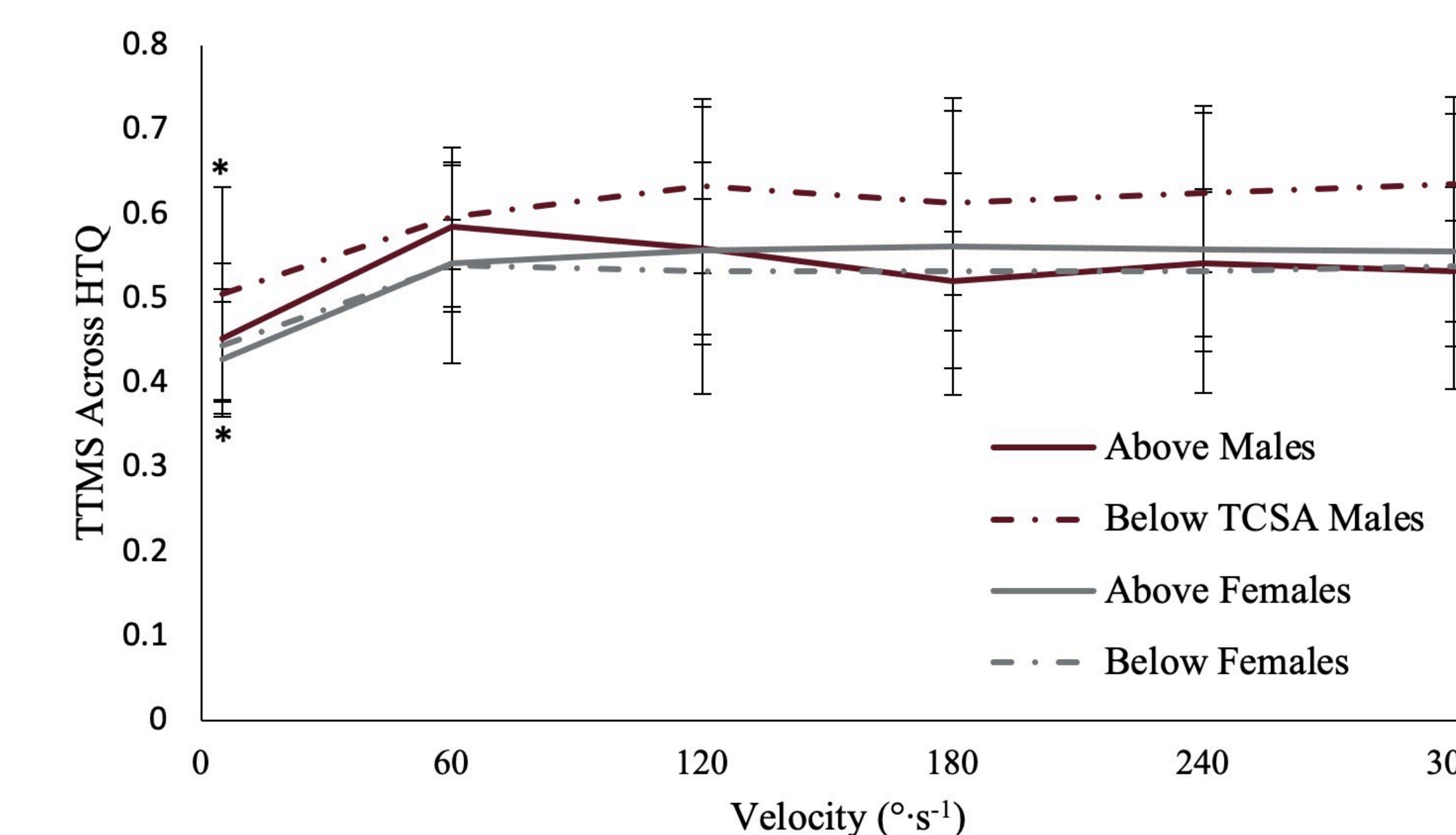
Strength and conditioning coaches and professionals can utilize HTQ to gauge potential muscular imbalances and augment programming, but it should not be the entire basis for assessing potential knee injury risk among an entire team. The present study demonstrates that stronger, and likely more strength trained, individuals may not yield superior HTQ. Strength and conditioning coaches and sport scientists should consider examining HTQ in conjunction with anthropometric and biomechanical factors for a holistic understanding potential knee injury risk.

RESULTS

When split by TTS, there were no sex- or group-based differences for HTQ (p≥0.349). For below average TTS females and males, HTQ did not change across velocity (p≥0.060). For females with above average TTS, HTQ from 120-300°·s⁻¹ was greater than MVIC (p≤0.017). For males with above average TTS, HTQ increased from MVIC to 60°·s⁻¹ (p=0.013) and then plateaued (p≥0.082). When split by TTMS, there were no sex- or group-based differences for HTQ (p≥0.276). When split by TTMS, HTQ increased from MVIC to 60°·s⁻¹ (p<0.001), and then plateaued (p=1.000) for all groups.



★ Indicates these are greater than MVIC for above average females,
▼ Indicates these are greater than MVIC for above average males



* Indicates lower than all other velocities