YOGA IMPROVES KNEE EXTENSOR STRENGTH BUT DOES NOT INFLUENCE MECHANICAL BEHAVIOR OR MUSCLE SIZE IN ACTIVE ADULTS

Stephanie Sontag[1], Lyric Richardson[2], Brenden Roth[2], Alex Olmos[3], Sunggun Jeon[4], and Michael Trevino[2]

[1]Louisiana State University, Baton Rouge, LA; [2]Oklahoma State University, Stillwater, OK; [3]Christopher Newport University, Newport News, VA Oklahoma State University, Stillwater, OK; [4]Northwestern State University, Natchitoches, LA

Purpose

Mechanomyography (MMG) is described as the mechanical counterpart to neural activation and is influenced motor unit (MU) behavior. The purpose was to examine the mechanical behavior of the vastus lateralis (VL) before (Pre) and after (Post) a yoga intervention.

Methods

Subjects: 21 recreationally, adult males and females
- Yoga: N = 11, age = 22.9 ± 4.5 yrs, body mass = 80.4 ± 15.3 kg
- Control (Con): N = 10, age = 21.5 ± 3.5 yrs, body mass = 71.3 ± 12.1 kg

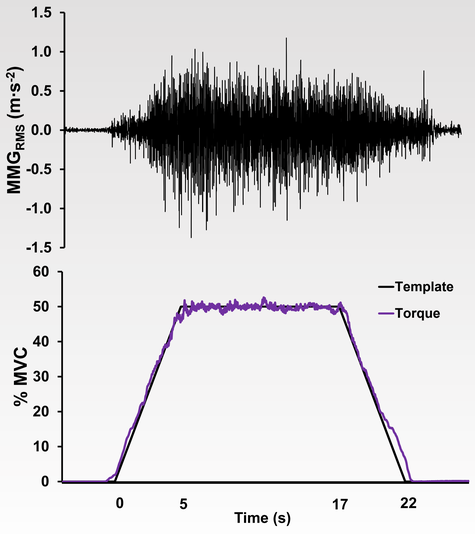
Intervention:
- Yoga: regular PA + 8 weeks of Hatha Vinyasa yoga, attending 2x/week (16, 1-hour sessions)
- Con: regular PA for 8 weeks without yoga

Ultrasound (US) measured at Pre and Post:
- Muscle cross-sectional area (mCSA) and echo intensity (EI) of the VL

Isometric Testing:
- Maximal Voluntary Contractions (MVC) of knee extensors Pre and Post
- Isometric trapezoidal muscle actions of the knee extensors were performed at 50% MVC
  - Linearly increasing at 10% MVC/s
  - Plateau held for 12s

Mechanomyography (MMG) Analysis:
- Surface MMG_{RMS} signals were recorded from the VL at Pre and $Post_{Rel}$ during the isometric trapezoidal muscle actions.
- For the plateau, MMG_{RMS} was normalized (N-MMG_{RMS}) to the respective MVC MMG_{RMS}.
- Simple linear regression were applied to the log-transformed MMG_{RMS} vs. torque relationships for the linearly increasing segment of the muscle action.

Statistical Analysis:
- Repeated Measures ANOVAS
- Paired samples *t*-tests
- Independent samples *t*-tests



Results

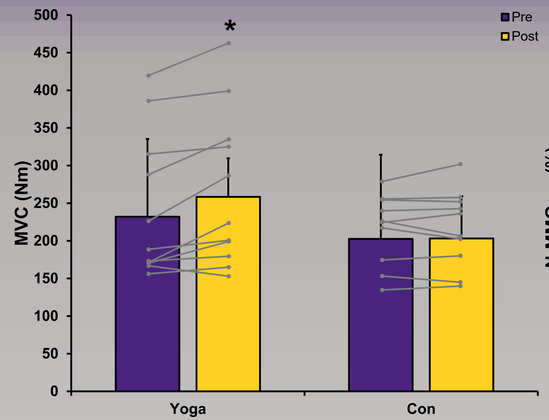


Figure 1. Plotted mean (SD) values for MVC. There was a significant group x time interaction (p = 0.010; ηp^2 = 0.301). Con had no improvements (p = 0.907, g = 0.01). * indicates an increase for Yoga from Pre to Post (p = 0.010, g = 0.30).

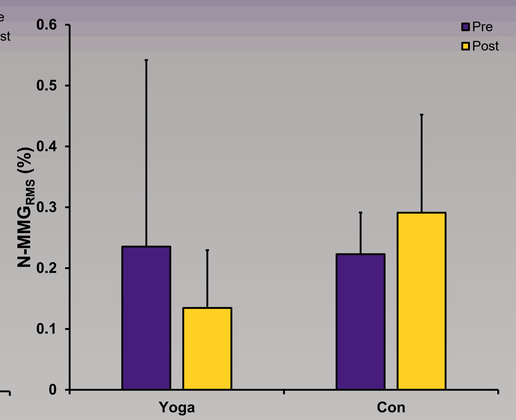
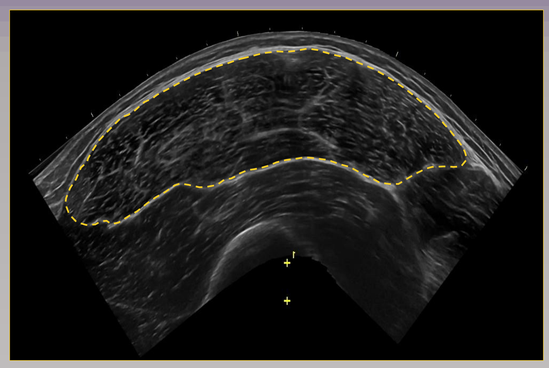


Figure 2. Plotted mean (SD) values for N-MMG_{RMS}. There was no interaction (p = 0.087; ηp^2 = 0.146), nor time (p = 0.730; ηp^2 = 0.006) or group (p = 0.289; ηp^2 = 0.059) effect.



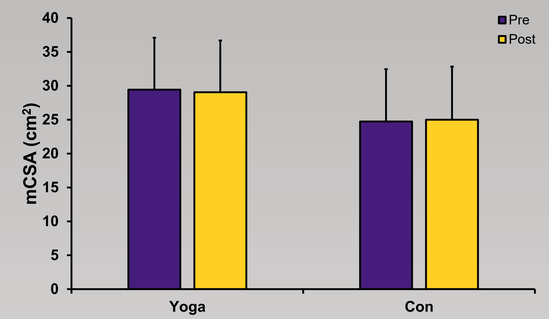


Figure 5. Plotted mean (SD) values for mCSA. There was no interaction (p = 0.279; ηp^2 = 0.061), nor time (p = 0.836; ηp^2 = 0.002), or group (p = 0.208; ηp^2 = 0.008) effect.

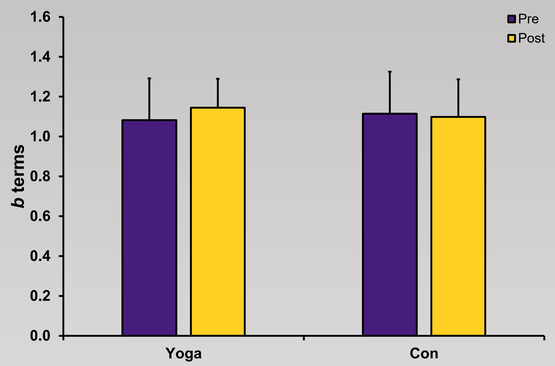


Figure 3. Plotted mean (SD) values for *b* terms. There was no interaction (p = 0.328; ηp^2 = 0.050), nor time (p = 0.560; ηp^2 = 0.018) or group (p = 0.927; ηp^2 < 0.001) effect.

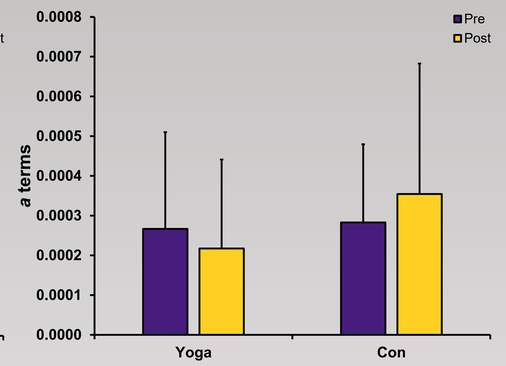


Figure 4. Plotted mean (SD) values for *a* terms. There was no interaction (p = 0.255; ηp^2 = 0.068), nor time (p = 0.829; ηp^2 = 0.003), or group (p = 0.440; ηp^2 = 0.032) effect.

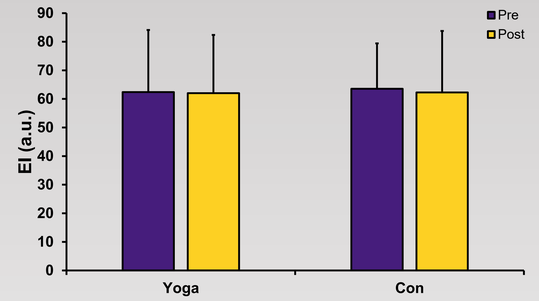


Figure 6. Plotted mean (SD) values for EI. There was no interaction (p = 0.787; ηp^2 = 0.004), nor time (p = 0.625; ηp^2 = 0.013) or group (p = 0.935; ηp^2 < 0.001) effect.

Conclusion

- Hatha Vinyasa **yoga can improve knee extensor strength when added to physical activity compared to physical activity alone**, despite *no changes in muscle size or quality.*
  - As a result, Yoga group had to produce greater torque during Post tests.
- There was no change in the gain (*a* terms) or the rate of change between MMG_{RMS} and torque (*b* terms) during the linearly increasing segment—suggesting there was no additional recruitment of higher threshold MUs to modulate torque.
  - Instead, torque may have been modulated by an increase in MU firing behavior as previously reported (Sontag et al. 2024).
    - MMG_{RMS} methods may not be a sensitive enough measure for the magnitude of strength improvement observed in this study.

Practical Application

- Even in an already active lifestyle, the addition of a yoga practice may further promote improvements in strength.

Reference

- Stephanie A. Sontag, Lyric D. Richardson, Alex A. Olmos, Brenden L. Roth, Sunggun Jeon, and Michael A. Trevino. Yoga influences strength and motor unit behavior but not muscle size in active adults. NSCA National Conference. Baltimore, MD, July 2024.

School of Kinesiology

NSCA® NATIONAL STRENGTH AND CONDITIONING ASSOCIATION