

## The Acute Effects of a Warm-Up Including Different Dynamic Stretching on Hamstring Stiffness, Flexibility, and Strength

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**Abstract :** A typical warm-up contains both stretching exercises and jogging. The static stretching prior to training or competition may cause detrimental effects to athletic performance. However, it is unclear whether different types of dynamic stretching exercises had different acute effects on knee flexors stiffness, flexibility, and strength. The purpose of this study was to analyze the knee flexors stiffness, flexibility, and strength gains after dynamic straight leg raise (DSLRL) and dynamic modified toe-touch (MTT) stretching. Sixteen healthy university active men (height  $176.27 \pm 4.03$  cm; weight  $72.27 \pm 8.90$  kg; age  $22.09 \pm 2.31$  years). After 5 minutes (8km/h) of running subjects performed 2 randomly ordered stretching protocols: DSLRL and MTT stretching protocols. There were a total of six, 30 seconds bouts of dynamic stretching (15 repetitions) with 30seconds rest between bouts. The outcome measures were maximal voluntary isokinetic concentric hamstring strength ( $60^\circ/s$ ), muscle flexibility test by passive straight leg raise (PSLR), active straight leg raise (ASLR), and muscle stiffness using ultrasound Acoustic Radiation Forced Impulse (ARFI) elastography before and immediately after stretching. The muscle stiffness and concentric strength decreased significantly ( $p < .05$ ), the flexibility no significant change after DSLRL protocol ( $p > .05$ ). The concentric strength decreased significantly ( $p < .05$ ), the flexibility and muscle stiffness no significant change after MTT protocol ( $p > .05$ ), whereas no significant differences were found for the DSLRL and MTT. Our findings suggest that dynamic stretching (30s x 6 bouts) resulted in change in muscle stiffness or may be induced slack in the musculotendinous unit thereby, reducing force production. Therefore, 30s x 6 bouts of dynamic stretching adversely affects efforts of hamstring muscle maximal concentric strength.

**Keywords :** sport injury, ultrasound, eccentric exercise, performance

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