

BACKGROUND

Soccer is a dynamic sport characterized by intermittent moderate to high intensity sprints, accelerations, and decelerations which are each underpinned by an athlete's ability to generate force. However, limited information is currently available regarding isometric force-time characteristics and how they change throughout a competitive season.

PURPOSE

To assess differences in female collegiate soccer athletes' isometric muscular strength characteristics prior to and after the end of a competitive season.

METHODS

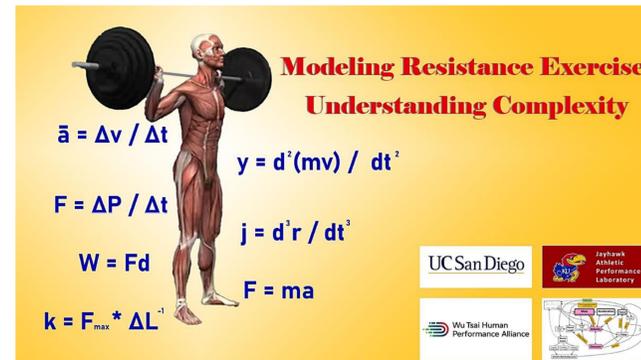
- Twenty-five resistance trained NCAA Division-II female soccer athletes (height: 168.45 ± 6.21 cm; weight: 70.72 ± 10.89 kg) participated in this study. Following a standardized dynamic warm-up, athletes performed 2-4 IMTP on a dual force plate system (1000 Hz sampling rate; Hawk Dynamics, ME, USA).
- The vertical ground reaction force of each IMTP was recorded and the best was included in final analyses. A Mann-Whitney U test was performed on all variables recorded by the dual force plate system and the Shapiro-Wilks test was also conducted to confirm normality. However, two metrics were found to be non-normal which resulted in a non-parametric analysis. The a-priori alpha level was set at 0.05 for all analyses.

RESULTS

- Force at 50ms (p<0.001), force at 150ms (p=0.042), average impulse 0-50ms (p=0.004), average impulse 0-150ms and (p=0.015) significantly differed between pre- to post-season, with post-season values being higher.
- Peak force, force at 200ms, impulse 0-250ms, rate of force development from 0-50ms, 0-150ms, and 0-250ms, as well as time to peak force did not differ significantly from pre- to post-season (p>0.05).

CONCLUSIONS

Findings from this study highlight specific changes in muscular strength force-time characteristics throughout the course of a competitive season. Specifically, for female collegiate soccer female athletes who regularly participated in strength and conditioning programming. Although force production did not change, neuromuscular force production characteristics improved.



The isometric mid-thigh pull (IMTP) is a criterion method for assessing muscular strength within athletic populations and if utilized in conjugation with a force plate, it can provide information about neuromuscular characteristics.

Table 1. Comparisons ($\bar{x} \pm SD$) of IMTP force-time characteristics.

Variable	Pre	Post
Force		
Mean Force at 50ms (N)	893.88 ± 136.80	1073.37 ± 258.79*
Mean Force at 100ms (N)	1057.68 ± 168.08	1266.71 ± 292.79
Mean Force at 150ms (N)	1253.44 ± 231.165	1409.31 ± 302.60*
Mean Force at 200ms (N)	1394.60 ± 261.19	1522.20 ± 321.45
Mean Force at 250ms (N)	1497.08 ± 295.45	1604.49 ± 325.23
Peak Force (N)	1707.40 ± 259.27	1808.43 ± 275.63
Impulse		
Mean Impulse at 50ms (N.s)	39.83 ± 5.25	44.02 ± 7.93*
Mean Impulse at 100ms (N.s)	88.71 ± 12.65	102.94 ± 21.39*
Mean Impulse at 150ms (N.s)	145.79 ± 21.50	169.91 ± 35.58*
Mean Impulse at 200ms (N.s)	212.02 ± 33.39	284.89 ± 46.84
Mean Impulse at 250ms (N.s)	284.59 ± 46.84	321.61 ± 65.38
Rate of Force Development		
Mean RFD at 50ms (N/s)	3666.40 ± 1811.75	7108.00 ± 4277.22*
Mean RFD at 100ms (N/s)	3471.20 ± 1336.93	5487.43 ± 2513.83*
Mean RFD at 150ms (N/s)	3619.20 ± 1343.54	4608.95 ± 1713.94
Mean RFD at 200ms (N/s)	3420.20 ± 1121.32	4021.14 ± 1324.24
Mean RFD at 250ms (N/s)	3146.08 ± 1034.92	3546.06 ± 1093.16

* = significantly different when compared to no arm swing condition (p < 0.05)

Figure 1. IMTP Force-Time Characteristics from sample.

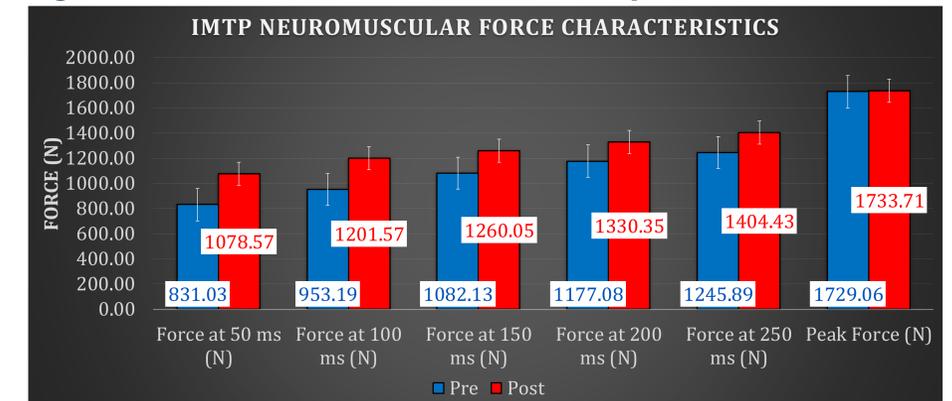


Table 2. Percentage of peak force at time epochs.

Phase	%Peak at 50ms	%Peak at 100ms	%Peak at 150ms	%Peak at 200ms	%Peak at 250ms
Pre	48%	55%	63%	68%	72%
Post	62%	69%	73%	77%	81%

PRACTICAL APPLICATIONS

- These findings provide unique insight into the neuromuscular strength characteristics of collegiate soccer athletes and highlight the benefits of resistance training throughout a competitive season.
- As observed in this study, resistance training can be utilized to enhance or at the least maintain physical characteristics such as muscular strength which contribute to more sport-specific tasks such as sprinting, accelerating, and decelerating.
- Future research may benefit from further examining optimal resistance training periodization approaches for the female soccer athlete population.

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