Relationship Between Strength Characteristics and Loaded and Unloaded Jumps in Division I Rowers

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Introduction

Strength is the ability to produce force and an important attribute to support and enhance an athlete's ability to perform a myriad of sporting tasks (DeWeese et al., 2015). Numerous studies have investigated strength power characteristics of local, national, and international rowers, however, very few studies have been performed on U.S. NCAA D1 female rowers. Therefore, the purpose of this study is to investigate the relationship between isometric strength characteristics and loaded and unloaded static (SJ) and countermovement jumps (CMJ) in Division I rowers.

Methodology

Subjects: 28 NCAA Division I female rowers (weight:73.02 ± 7.64) participated in this study. This study was granted approval by West Virginia University's Institutional Review Board.

Design: The experimental design of this study was hypothesis-generating.

Methodology: In this study, force-plate technology was used to measure isometric force-time characteristics using the isometric mid-thigh pull (IMTP) and additional force plates were used to measure jump height. SJ and CMJ jump heights were both measured with loaded (20kg) and unloaded (bodyweight) weights.

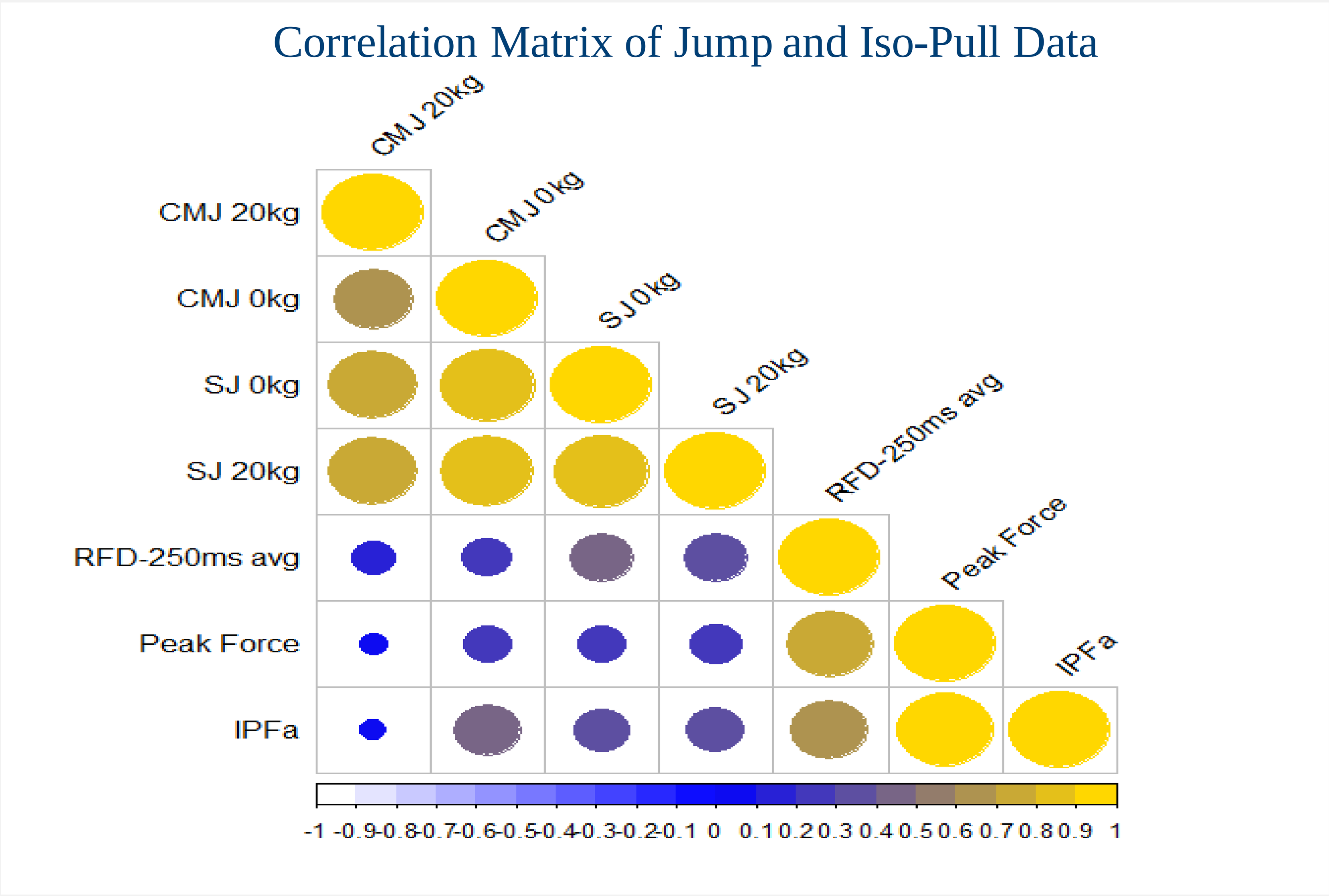
Statistical Analysis: Test-retest reliability between trials was assessed through Intra-class Correlation Coefficient (ICC). A Pearson's Correlation Coefficient was conducted to assess the relationship between force-time variables of interest and jump height at various loads in two different types of jumps. The criterion for statistical significance of these relationships was $P \leq .05$. Additional analyses comparing strongest to the weakest athletes using isometric strength data and jump height data were conducted. Based on allometrically scaled peak force (IPFa), rowers were sorted into groups of the strongest ($n = 4$) 15% and the weakest ($n = 4$) 15%. Differences in mean isometric strength data and mean jump height data between groups were determined by two-tailed independent samples t tests (strong group IPFa = 191.2 ± 14.4 N/Kg0.67, weak group IPFa = 132.6 ± 7.2 N/Kg0.67 $p < .05$).

Countermovement jump on force-platforms

Isometric mid-thigh pull on force-platforms using a Kairo rack

Results

The results of the Pearson Correlation Coefficient indicate that there were moderate correlations between SJ loaded jumps and RFD-250ms ($r = 0.37$), SJ unloaded jumps and RFD-250ms ($r = 0.40$), and unloaded CMJ and IPFa ($r = 0.44$). There was a strong correlation between RFD-250ms and IPFa ($r = 0.6$). There was a very strong correlation between IPF and RFD-250ms ($r = 0.75$). The results of the independent t test indicate that there were no significant differences between groups in jumping performance ($p > .05$). However, there were significant differences between groups in IPF, RFD-250ms, and IPFa ($p < .05$).



Discussion

In competition, rowers produce force repeatedly, in a seated fashion, in large part via their lower extremity in an effort to displace the oar through water (Baudouin, 2002). The ability to produce and repeat high power outputs has been observed in high level competitive rowers (Kleshnev, 2002; Lawton et al., 2013). Based on cross-sectional and longitudinal data, athletes that possess greater strength exhibit greater power outputs (Harris et al., 2000; Cormie et al., 2010).

The relationship between strength characteristics and jumping ability in Division I rowers appears to be complex. A rower's explosiveness (RFD) may contribute to the height of their loaded and unloaded SJ and it appears that IPFa is an influencing characteristic in RFD and unloaded CMJ. The subjects in this study did not have a wide strength spectrum, this may have influenced comparisons between groups. In agreement with Kraska et al. (2009), it appears that strong athletes are better able to develop force at high rates. When comparing stronger to weaker rowers, jumping performance does not appear to distinguish the two groups, in contrast, isometric force-time characteristics influence the differences between groups

Practical Applications

An S&C coach for NCAA Division I rowers may consider prioritizing strength training as it appears to influence RFD. Furthermore, strength characteristics in rowers may influence power output to a moderate degree. Strength and endurance are conflicting adaptations. Thus, it may be beneficial to emphasize and de-emphasize these variables throughout the training program.

References

Baudouin, A. (2002). A biomechanical review of factors affecting rowing performance. *British Journal of Sports Medicine*, 36(6), 396–402. https://doi.org/10.1136/bjsm.36.6.396

Cormie, P., McGuigan, M. R., & Newton, R. U. (2010). Adaptations in athletic performance after ballistic power versus strength training. *Med Sci Sports Exerc*, 42(8), 1582-1598.

DeWeese, B. H., Hornsby, G., Stone, M., & Stone, M. H. (2015). The training process: Planning for strength–power training in track and field. Part 1: Theoretical aspects. *Journal of Sport and Health Science*, 4(4), 308–317. https://doi.org/10.1016/j.jshs.2015.07.003

Harris, G. R., Stone, M. H., O'Bryant, H. S., Proulx, C. M., & Johnson, R. L. (2000). Short-term performance effects of high power, high force, or combined weight-training methods. *The Journal of Strength & Conditioning Research*, 14(1), 14-20.

Kleshnev, V. (2002). Power in rowing. *International research in sports biomechanics*, 224-230.

Kraska, J. M., Ramsey, M. W., Haff, G. G., Fethke, N., Sands, W. A., Stone, M. E., & Stone, M. H. (2009). Relationship Between Strength Characteristics and Unweighted and Weighted Vertical Jump Height. *International Journal of Sports Physiology and Performance*, 4(4), 461–473. https://doi.org/10.1123/ijspp.4.4.461

Lawton, T. W., Cronin, J. B., & McGuigan, M. R. (2013). Strength, power, and muscular endurance exercise and elite rowing ergometer performance. *The Journal of Strength & Conditioning Research*, 27(7), 1928-1935.