COMPARISON OF FORCE-TIME CHARACTERISTICS IN COLLEGIATE WEIGHTLIFTERS USING TWO ISOMETRIC PULL PROTOCOLS

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Introduction

The isometric mid-thigh pull (IMTP) is a multi-joint isometric force monitoring test that can be used to assess athletes' force-time characteristics (Stone et al., 2019). The IMTP is especially useful for the monitoring of weightlifters because it closely resembles the power position of the clean (Beckham et al., 2013). Therefore, another viable isometric test to use might be an isometric pull from the floor (IPFF) because it mimics the position at the start of the clean (Joffe et al., 2021).

Purpose

The purpose of this study was to compare the force-time characteristics of collegiate level weightlifters in two types of multi-joint isometric force tests and their relationship to competition performance.

Methods

In this study, force-plate technology (Hawkins Dynamics, Westbrook, ME) was used to measure isometric force-time characteristics in collegiate weightlifters. Thirteen collegiate male and female weightlifters (6 males; weight:89.0 ± 10.8, 7 females; weight:74.0 ± 8.1) performed the IMTP test followed by the IPFF test within one month of their competition performances. For the IMTP test, the participants were instructed to stand on force plates and orient their body in the same position of the second pull in the clean. Knee angles were then measured with a goniometer for a knee angle of 125-145 in accordance with Comfort et al. (2018). The participants were given two warm-up pulls at 50% and 75% of maximum effort for both isometric tests. The participants were instructed to pull hard and fast. Two max effort trials were taken for both isometric tests. 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 weightlifting performance variables in the SN, CJ, and TOT.

Figure 1.

Figure 2.

Figure 1 shows the isometric mid-thigh pull using a Kairos IMTP rack (Kairos Strength, Murphy, NC) while the participant exerts force into the force plates below. Figure 2 shows the participant in the isometric pull from the floor position. Hands are taped to the bar to remove grip strength as a limiting factor.

Results

The ICC showed a high degree of reliability between trials for isometric peak force (IPF) and rate of force development 0-250ms (RFD) in both protocols. For IPFF, the average measure ICC was .989 (95% CI [.966, .996], F(1,12)= 84.971 p<.001) and an average ICC of .919 (95% CI [.745, .974], F(1,12)= 11.549 p<.001) respectively. For IMTP, the average measure ICC was .985 (95% CI [.954, .995], F(1,12)=62.8 p<.001) and an average ICC of .936 (95% CI [.798, .979], F(1,12)=14.508 p<.001) respectively. Results from the correlation analysis between IMTP, IPF, and weightlifting performance indicated that there were Large (.671), Very Large (.711), and Large (.692) correlations with SN, CJ, and TOT performances, respectively. The analysis between IPFF IPF and weightlifting performance showed Very Large (.806), Very Large (.853), and Very Large (.836) correlations with SN, CJ, and TOT, respectively. The analysis between IMTP, RFD, and weightlifting performance showed Large (.661), Very Large (.700), and Large (.681) correlations with SN, CJ, and TOT, respectively. The analysis between IPFF, RFD, showed Very Large (.761), Very Large (.785), Very Large (.781) correlations for SN, CJ, and TOT.

Table 1

Means, standard deviations, and correlations with confidence intervals

Variable	*M*	*SD*	1	2	3	4	5	6
1. Peak Force MTP	4214.94	1015.58						
2. Peak Force PFF	2170.12	468.65	.86** [.58, .96]					
3. RFD 0-250 ms MTP	7054.36	2738.94	.89** [.67, .97]	.81** [.47, .94]				
4. RFD 0-250 ms PFF	2818.62	941.09	.81** [.47, .94]	.90** [.68, .97]	.92** [.75, .98]			
5. Best Snatch	80.38	22.62	.67* [.19, .89]	.81** [.46, .94]	.66* [.17, .89]	.76** [.36, .92]		
6. Best C&J	102.46	26.28	.71** [.26, .91]	.86** [.58, .96]	.69** [.23, .90]	.79** [.43, .94]	.99** [.96, 1.00]	
7. Total	182.85	48.75	.69** [.23, .90]	.84** [.53, .95]	.68* [.21, .90]	.78** [.40, .93]	1.00** [.99, 1.00]	1.00** [.99, 1.00]

Conclusion

Both the IMTP and IPFF multi-joint isometric protocols are both reliable and valid ways to monitor weightlifting performance. The IPFF protocol had somewhat stronger correlations to weightlifting performance in collegiate level athletes than the IMTP protocol.

Practical Implications

IMTP and IPFF protocols can be used by the coach to monitor collegiate weightlifters for program efficacy and adaptations to training. The IPFF protocol may be more time efficient to use for some professionals because the bar height would not need adjusting between athletes. However, for maximal strength assessment it is notable that IMTP had much greater IPF. Furthermore, the IPFF position would likely raise injury potential as the back is in a weak position.

References

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