Normative Data of Load-Velocity Relationship Variables from Isometric Mid-thigh Pull and Countermovement Jump in Elite Athletes

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Introduction

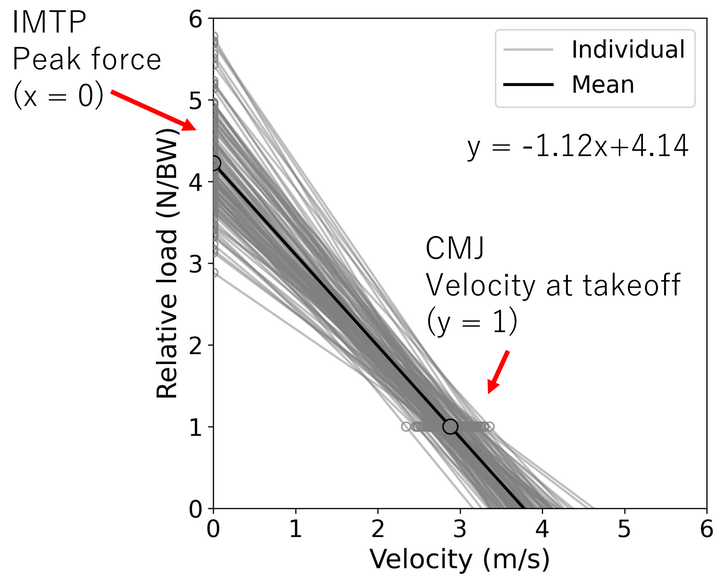
- Dynamic Strength Index (DSI), defined as the ratio of peak force during an Isometric Mid-Thigh Pull (IMTP) and a Countermovement Jump (CMJ), is frequently used to assess an athlete's force potential and create individualized training plans (Suchomel et al., 2020).
- DSI has limitations as peak force during a CMJ can vary depending on jumping strategy (Kennedy & Drake, 2018).
- Load-Velocity (L-V) relationship profiles offer additional insight into an athlete's mechanical capacities; however, the increased impulse during landing under high load is a concern (Lake et al., 2018).

Purpose:

- Propose a novel method to establish a dynamic force production and maximal force capacity profile by modifying the DSI and 2-point L-V approach .
- Provide normative data to quantify inter-personal variability and the tendency of these variables.

Results & Discussions

	Peak force (N/BW)	V@takeoff (m/s)	CMJ height (m)	Slope	V @y=0 (m/s)
Mean	4.22	2.86	0.42	-1.13	3.78
SD	0.57	0.19	0.06	0.19	0.26
100%	5.75	3.34	0.57	-0.71	4.56
95%	5.30	3.21	0.52	-0.82	4.21
90%	4.98	3.14	0.50	-0.89	4.12
85%	4.82	3.08	0.48	-0.93	4.07
80%	4.71	3.03	0.47	-0.97	4.00
75%	4.58	2.98	0.45	-1.01	3.93
70%	4.48	2.94	0.44	-1.03	3.88
65%	4.37	2.92	0.44	-1.06	3.83
60%	4.28	2.89	0.43	-1.08	3.80
55%	4.21	2.86	0.42	-1.10	3.78
50%	4.14	2.84	0.41	-1.12	3.75
45%	4.08	2.83	0.41	-1.14	3.73
40%	4.02	2.80	0.40	-1.16	3.70
35%	3.97	2.77	0.39	-1.19	3.67
30%	3.91	2.75	0.39	-1.21	3.64
25%	3.85	2.73	0.38	-1.24	3.61
20%	3.78	2.70	0.37	-1.28	3.57
15%	3.70	2.68	0.37	-1.31	3.52
10%	3.58	2.64	0.36	-1.37	3.46
5%	3.39	2.58	0.34	-1.46	3.39
0%	2.98	2.39	0.29	-1.67	3.21



- IMTP peak force and CMJ takeoff velocity both have high repeatability and are valid tools for strength and velocity assessments (Suchomel et al., 2020).
- Inter-individual variability in the IMTP peak force seems to be greater than in the CMJ takeoff velocity.
- DSI is highly influenced by the IMTP peak force.

(Suchomel et al., 2020).

Methods

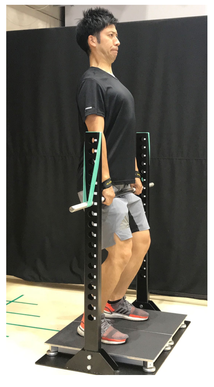
Participants: 124 international-level male athletes ≧ 18 years old (23.5 ± 4.4 years, 1.82 ± 0.12 m, 81.3 ± 14.0 kg) from various sports environments (6 water, 9 precision, 5 winter, 73 ball-game, 37 racket, 17 combat).

Two-point method for L-V relationship

- At x = 0 (isometric), where y = IMTP relative peak force.
- At x = CMJ takeoff velocity, where y = 1 (body weight).
- Slope: IMTP relative peak force / CMJ takeoff velocity

Analysis

- Python (v3.9.13)
- Bootstrap resampling technique (20,000 iterations) to establish percentile scores.



Hawkin Dynamics (1000 Hz)

CMJ (2-3 trials): Takeoff velocity and height

"Jump as high as possible using a countermovement with a knee angle of approx. 90-deg."

IMTP (2-3 trials): Peak force

- Standardized methods from Comfort et al. (2019)
- "Push your feet into the ground as fast and as hard as possible."

Conclusions and Practical applications

- When using the L-V slope, it is critical to consider not only the ratio itself, but also the components of the ratio (Comfort et al., 2018).
- Normative values of IMTP peak force, takeoff velocity, and their ratio should help S&C coaches in designing training programs.

References

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