USE THE HIGHEST DISPLACEMENT WHEN MEASURING VERTICAL JUMP CHARACTERISTICS

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INTRODUCTION

High stability reliability but poor precision were previously found in our laboratory for several kinetic and kinematic variables obtained during vertical jumping. In those cases, data for each variable were averaged from multiple jump attempts over two sessions. However, although each attempt was designed to be a maximum effort, the fitness-trained individuals in some cases may have exhibited random jump-to-jump inconsistencies, that, when averaged, resulted in force, velocity, and power outputs that were unreflective of any of the individual's single attempts. More consistent day-to-day outcomes might be obtained by using the jump with the greatest displacement at each testing session for data extraction, a procedure analogous to the scoring done for field events in track and field competitions.

PURPOSE

- To determine the stability reliability and precision of absolute and normalized (for body mass) expressions of peak vertical ground reaction force (PkvGRF), peak vertical velocity (PkVz, absolute expression only), peak vertical power (PkPz), and concentric work (W) during countermovement vertical jumps (CMVJ) based on the attempt from each session with the highest jump displacement.

METHODS

Sixty young, fitness-trained adults (31 men, 29 women), 18 to 35 years of age, performed three vertical jumps (CMVJ) on two occasions using a self-selected countermovement depth and constrained arm swing. A nine-camera 3D motion capture system (240 Hz, Qualisys Inc., Sweden) and force platform (1200 Hz, AMTI, Watertown, MA, USA) were used to collect 3D marker position data and vertical ground reaction force (vGRF) data for the right side of the body, respectively. Velocity (meters per second) was based on the center-of-mass displacement with respect to time. Power (watts) was calculated as the product of vGRF and center-of-mass vertical velocity. Concentric work (joules) was calculated from vGRF with respect to displacement starting at a point corresponding to the lowest center of mass and ending at toe-off. Except for velocity, all measures were expressed both as absolutes and normalized for body mass. Statistical analyses were performed on variables obtained from the jump having the greatest displacement. Stability reliability (relative reliability) was determined using an intraclass correlation coefficient (two-way random model), while precision (absolute reliability) was assessed using both the standard error of measurement and the coefficient of variation percentage. Occasional marker data were corrupted resulting in some missing values.

RESULTS

Both reliability and precision were high for all variables based on the best jump (See Table 1.) Sample depictions below are of vGRF and Vz based on *average* (Fig 1) and *best* (Fig.2) jump.

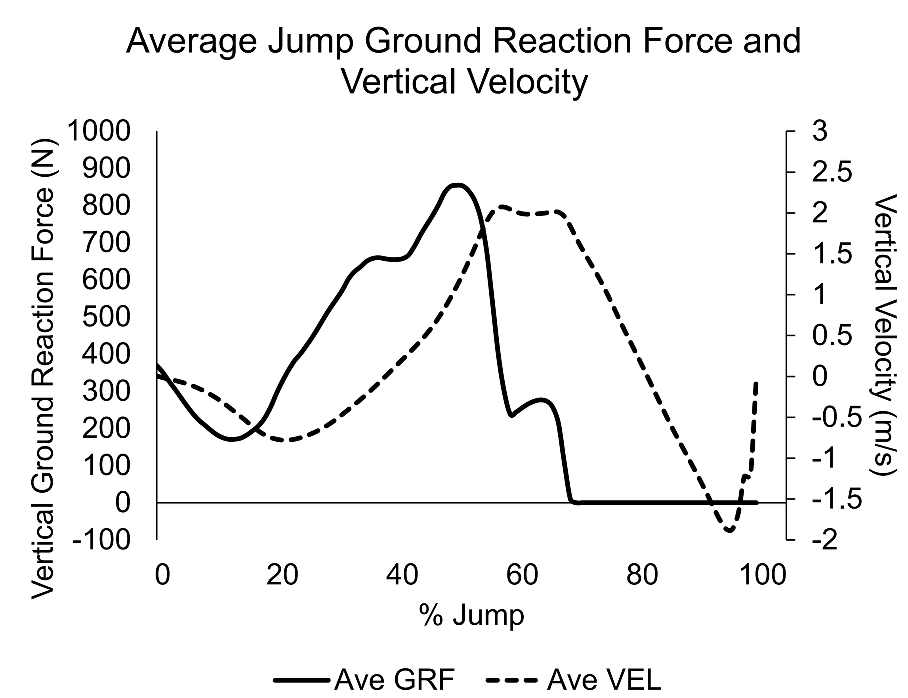

Fig. 1. Sample ground reaction force and center-of-mass vertical velocity based on the average of three vertical jump attempts (average jump).

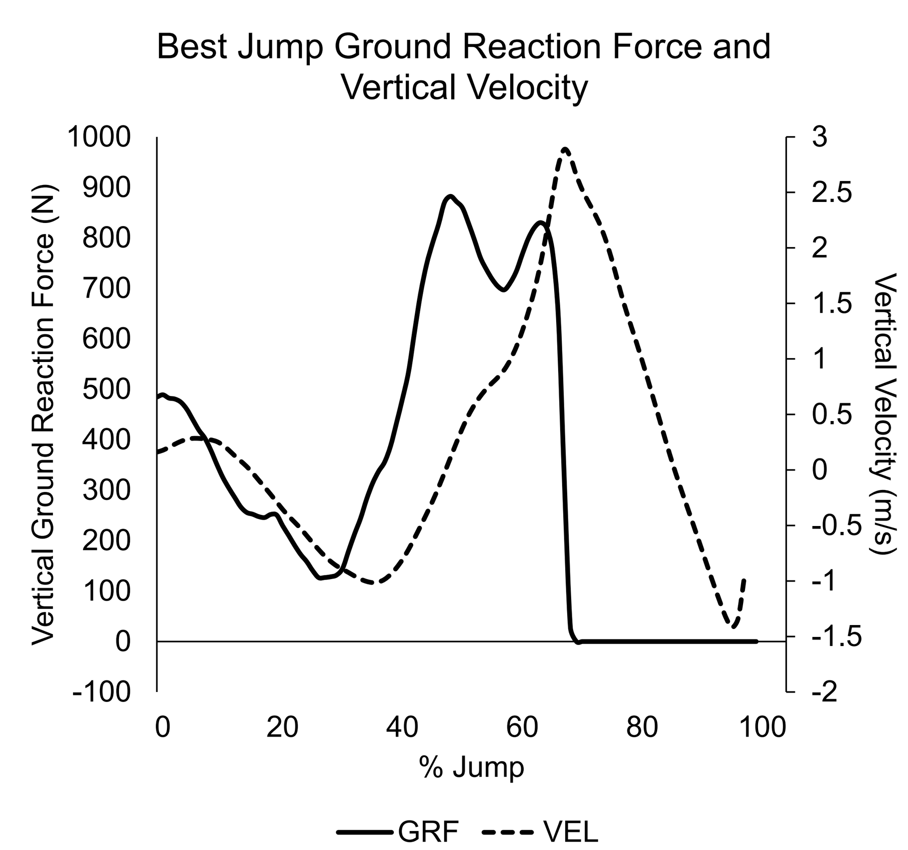

Fig. 2. Using the same subject as in Fig. 1 above, sample ground reaction force and center-of-mass vertical velocity from the vertical jump attempt with the greatest displacement (best jump).

Table 1. Descriptive data, stability reliability, and precision of variables acquired from the best of three vertical jumps at each of two sessions using fitness-trained subjects.

Session	*Variable*	Sample Size	Mean	Std. Dev.	ICC (95% CI)	SEM (CV%)
1	CMVJ (m)	56	0.33	0.13	0.99	0.02
2	CMVJ (m)	60	0.35	0.23	(0.99-0.99)	(5.9)
1	PkvGRF (N)	56	830.45	247.58	0.97	46.77
2	PkvGRF (N)	58	818.06	258.80	(0.95-0.98)	(8.0)
1	PkvGRF Norm ($N \cdot kg^{-1}$)	56	11.29	2.08	0.91	0.65
2	PkvGRF Norm ($N \cdot kg^{-1}$)	58	11.29	2.07	(0.86-0.94)	(8.0)
1	PkVz ($m \cdot s^{-1}$)	56	2.72	0.42	0.94	0.09
2	PkVz ($m \cdot s^{-1}$)	58	2.69	0.34	(0.91-0.96)	(4.8)
1	PkPz· (W)	56	1843.94	696.21	0.99	65.09
2	PkPz (W)	58	1780.12	679.00	(0.99-0.99)	(5.1)
1	PkPz Norm ($W \cdot kg^{-1}$)	56	24.70	6.27	0.98	0.90
2	PkPz Norm ($W \cdot kg^{-1}$)	58	24.22	6.92	(0.97-0.99)	(5.2)
1	Con Work (J)	56	266.98	91.93	0.98	14.29
2	Con Work (J)	58	258.98	91.25	(0.96-0.98)	(7.7)
1	Con Work Norm ($J \cdot kg^{-1}$)	56	3.60	0.74	0.93	0.19
2	Con Work Norm ($J \cdot kg^{-1}$)	58	3.55	0.65	(0.89-0.95)	(7.6)

CONCLUSIONS

- For populations like the one used in this study, it appears that when the highest displacement from a series of countermovement vertical jumps is used, extracted peak vGRF, peak velocity, peak power, and concentric work to take-off are likely to be both reliable and precise.

PRACTICAL APPLICATIONS

- These findings suggest for fitness-trained young men and women that a single session may be used to represent the extracted peak vGRF, peak vertical velocity, peak power, and concentric work to take-off during the countermovement vertical jump when the highest single jump displacement is used for analysis.