FORCE-TIME DIFFERENCES BETWEEN THE STATIC HEXAGONAL BARBELL JUMP AND SQUAT JUMP IN RESISTANCE-TRAINED WOMEN

S.M. Camacho[1], C-T Ho[1], N.C. Raatz[1], S.M. McKeever[2], J.P. Lake[3,4], T.J. Suchomel[1]
[1]Carroll University, Waukesha, WI
[2]Divine Savior Holy Angels High School, Milwaukee, WI
[3]University of Chichester, Chichester, UK
[4]Edith Cowan University, Joondalup, Australia

Introduction

Static jumps may be performed from various starting positions and involve jumping without a countermovement. Researchers have indicated that static jumps may enhance an athlete's ability to produce force quickly during the concentric phase of the exercises (3). However, practitioners should note that the placement of the load, such as during hexagonal barbell jumps (HEXJ) and squat jumps (SJ), may vary the force production characteristics of the exercise (1,2). The rationale behind these findings is that the HEXJ may have a greater mechanical advantage due to the resistance being arm's length away and with an individual's center of mass (2). While the previous research has examined the differences between the HEXJ and SJ performed with a countermovement, there is little research that has compared the force-time characteristics between static HEXJ and SJ with female athletes. Hence, the purpose of this study was to examine the differences in force-time characteristics between the HEXJ and SJ in female athletes.

Methods

- 12 resistance-trained women participated in two separate testing sessions that required them to perform either static HEXJ or SJ repetitions using 0, 20, 40, 60, 80 and 100% of their body mass (BM) as loads.
  - Age = 21.7 ± 3.1 years, height = 165.8 ± 5.1 cm, BM = 66.3 ± 5.7 kg)
- HEXJ and SJ repetitions were performed on a force platform from a static starting position with the respective barbells resting on the floor or on boxes, respectively.
- Subjects either squatted down to the barbell (HEXJ) or under the barbell (SJ) to assume a knee angle of approximately $90° \pm 5°$ and held a quiet standing period of at least one second before receiving a countdown prior to each jump trial.
- The raw force-time data was used to calculate propulsion net relative mean force (NETRELMF), duration (DUR), and net impulse (NETIMP).
- A series of 2 (exercise) x 6 (load) repeated measures ANOVA with Bonferroni post hoc tests were used to compare the force-time characteristics produced during the HEXJ and SJ performed at each BM load.
- Hedge's g effect sizes were calculated to provide a measurement of the magnitude of the difference between exercises.

Results

Table 1. Hexagonal barbell (HEXJ) and squat jump (SJ) force-time characteristics.

Load (% BM)	Net Mean Force (N/kg)			Duration (s)			Net Impulse (Ns)		
	HEXJ	SJ	g	HEXJ	SJ	g	HEXJ	SJ	g
0	6.6 ± 0.7	6.8 ± 0.7	0.20	0.39† ± 0.04	0.34 ± 0.03	1.33	167.5# ± 11.6	149.0 ± 11.1	1.57
20	7.2 ± 0.9	8.1* ± 0.7	1.12	0.38† ± 0.03	0.32 ± 0.04	1.83	176.8 ± 15.7	166.0 ± 14.4	0.69
40	6.7 ± 1.0	8.2* ± 0.6	1.73	0.43† ± 0.05	0.33 ± 0.03	2.41	185.5# ± 17.2	177.1 ± 14.8	0.51
60	6.5 ± 0.8	8.0* ± 0.6	1.99	0.45† ± 0.03	0.36 ± 0.03	2.89	192.7# ± 20.6	186.8 ± 16.2	0.31
80	6.0 ± 0.9	7.3* ± 0.6	1.67	0.50† ± 0.04	0.40 ± 0.04	2.29	194.2# ± 19.9	188.3 ± 20.2	0.28
100	5.6 ± 1.0	6.7* ± 0.6	1.28	0.54† ± 0.09	0.43 ± 0.04	1.57	195.3# ± 21.2	189.5 ± 16.6	0.29

BW = body weight; g = Hedge's g effect sizes comparing HEXJ and SJ values; *= significantly greater than HEXJ value (p<0.01); † = significantly greater than SJ value (p<0.002) # = significantly greater than SJ value (p<0.05)

Conclusions

- Greater propulsion NETRELMF was produced during the SJ compared to the HEXJ.
- In contrast, greater DUR and NETIMP magnitudes were produced during the HEXJ across the loading spectrum.

Figure 1. Static hexagonal barbell jump sequence.

Figure 2. Squat jump sequence.

Practical Applications

- Both the HEXJ and SJ may provide an effective training stimulus for resistance-trained women.
- If the training goal is to maximize the rapid force production characteristics of an individual, the SJ may be a better alternative to the static HEXJ when performed with the same relative load due to ability to produce more net force over a shorter duration.
- Since the external load can influence the force production characteristics of the HEXJ and SJ exercises, practitioners should prescribe loads based on the sought after performance characteristic.
- It is important to understand the limitations of using loads based on percentages of BM as individuals may respond differently to the training stimulus based on their relative strength characteristics.

References

1. Suchomel TJ, McKeever SM, Sijuwade O, Carpenter L, McMahon JJ, Loturco I, Comfort P. The effect of load placement on the power production characteristics of three lower extremity jumping exercises. *J Hum Kinet* 68: 109–122, 2019.
2. Swinton PA, Stewart AD, Lloyd R, Agouris I, Keogh JWL. Effect of load positioning on the kinematics and kinetics of weighted vertical jumps. *J Strength Cond Res* 26: 906–913, 2012.
3. Van Hooren B, Zolotarjova J. The difference between countermovement and squat jump performances: A review of underlying mechanisms with practical applications. *J Strength Cond Res* 31: 2011–2020, 2017.

scamacho@carrollu.edu