THE DIFFERENCES IN FORCE-TIME CHARACTERISTICS PRODUCED DURING THE STATIC HEXAGONAL BARBELL JUMP BETWEEN STRONGER AND WEAKER MEN

Cheng-Ting, Ho[1], Sofia M. Camacho[1], Nathan C. Raatz[1], Shana M. McKeever[2], Jason P. Lake[3,4], Timothy 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
[5]Department of Exercise Science, Sacred Heart University, Fairfield, CT, USA

Introduction

Lower extremity ballistic exercises (e.g., jumping exercises) are often used to develop power characteristics that may transfer to sports performance because of their ability to train the triple extension of the hip, knee, and ankle (plantar flexion) joints (1). Since heavier loads can increase force production during jumping (1), weighted jumps, such as the hexagonal barbell jump (HEXJ), have become popular resistance exercises for developing muscular power. Researchers have shown that the HEXJ produced greater force, velocity, and power compared to the same movements using a traditional barbell (2-4). Despite these findings, no research has compared the force production characteristics of stronger and weaker individuals. Therefore, the purpose of this study was to compare the force-time characteristics of the static hexagonal barbell jump (HEXJ) between stronger and weaker men.

Methods

- 20 resistance-trained men were placed into two different groups based on the ratio of their one repetition maximum (1RM) back squat and body mass (BM).
  - Stronger group (n = 8, age = 24.6 ± 3.7 years, height = 169.3 ± 10.0 cm, BM = 79.1 ± 14.9 kg, relative 1RM back squat = 2.19 ± 0.18 kg/kg)
  - Weaker group (n = 12, age = 22.7 ± 2.2 years, height = 178.9 ± 5.2 cm, BM = 79.9 ± 10.0 kg, relative 1RM back squat = 1.71 ± 0.12 kg/kg).
- Each subject participated in two testing sessions including a 1RM back squat and familiarization session and a HEXJ testing session.
- During the HEXJ testing session, each subject performed two unloaded HEXJ repetitions and with 20, 40, 60, 80, or 100% of their BM on a force platform.
- Each HEXJ repetition was performed from a static starting position with the HEX barbell resting on the floor. Subjects squatted to a knee angle of approximately 90° and held a quiet standing period of at least one second before receiving a countdown prior to each jump trial.
- Raw force-time data were used to calculate propulsive relative net mean force (MF), phase duration (Dur), and net impulse (IMP).
- A series of 2 (strength) x 6 (load) repeated measures ANOVA were used to compare the force-time characteristics produced by stronger and weaker subjects. In addition, Hedge's g effect sizes were calculated to examine the magnitude of the differences between groups.

Results

Table 1. Hexagonal barbell jump propulsion relative net mean force (MF), phase duration (Dur), and net impulse (Imp) performances with different percentages of body mass (BM).

Load (%BM)	Variable								
	MF (N·kg^{-1})			Dur (s)			IMP (N·s)		
	Stronger	Weaker	g	Stronger	Weaker	g	Stronger	Weaker	g
BM	8.8 ± 1.3	8.6 ± 0.9	0.24	0.34 ± 0.04	0.35 ± 0.02	0.52	231.7 ± 46.5	238.5 ± 22.6	0.19
20	9.5 ± 1.4	8.9 ± 0.9	0.55	0.35 ± 0.03	0.36 ± 0.03	0.34	260.4 ± 54.6	255.6 ± 35.5	0.10
40	9.6 ± 1.1	9.2 ± 1.0	0.43	0.37 ± 0.02	0.38 ± 0.03	0.61	277.5 ± 54.1	277.8 ± 33.5	0.01
60	9.5 ± 1.8	8.6 ± 1.4	0.70	0.39 ± 0.02	0.43 ± 0.02	1.75	291.8 ± 62.2	292.1 ± 41.7	0.01
80	8.8 ± 1.2	8.1 ± 0.9	0.68	0.43 ± 0.02	0.46 ± 0.04	0.84	299.2 ± 64.6	294.2 ± 36.0	0.10
100	8.0 ± 1.1	8.0 ± 1.4	0.01	0.47 ± 0.01	0.46 ± 0.07	0.07	295.8 ± 68.4	288.4 ± 33.1	0.14

g = Hedge's *g* effect size between stronger and weaker groups.

Figure 1. Starting (left) and propulsive (right) position of the subject on the force platform executing static HEXJ.

Conclusions

- There were no statistical differences between stronger and weaker resistance-trained men for propulsion MF, Dur, or IMP during the static HEXJ
- Moderate-large effect sizes indicated that the stronger group may produce greater forces over shorter durations at various loads. In addition, HEXJ performance can be significantly impacted by external load used.

Practical Applications

- Both stronger and weaker resistance-trained men may benefit from using the static HEXJ in training;
- Stronger individuals may be able to use heavier loads (e.g. 60-80% BM) more effectively.

References

1. Moir GL, Gollie JM, Davis SE, Guers JJ, Witmer CA. The effects of load on system and lower-body joint kinetics during jump squats. *Sports Biomech* 11: 492-506, 2012.
2. 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, 2019.
3. Swinton PA, Lloyd R, Keogh JW, Agouris I, Stewart AD. A biomechanical comparison of the traditional squat, powerlifting squat, and box squat. *J Strength Cond Res* 26: 1805-1816, 2012.
4. Swinton PA, Stewart AD, Lloyd R, Agouris I, Keogh JW. Effect of load positioning on the kinematics and kinetics of weighted vertical jumps. *J Strength Cond Res* 26: 906-913, 2012.

@train_for_it_1995

kuoting11ho@gmail.com