A COMPARISON OF TRADITIONAL AND FLYWHEEL INERTIAL TRAINING SQUAT LOAD-VELOCITY CHARACTERISTICS

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Introduction

Flywheel inertial training (FIT) is a training method that provides an eccentric training stimulus based on the concentric effort used during an exercise performed on a flywheel device (3). FIT squats are commonly prescribed with these devices and training loads are based on inertial wheel size. Although researchers have shown that an increased training stimulus can be provided using larger inertial loads (1), training load can be difficult to monitor during FIT. Some researchers have suggested that concentric movement velocity may be used to track and monitor the training load stimulus provided during FIT exercises (1,2); however, no research has compared the velocities and loads to the traditional back squat exercise. Given that the traditional back squat is prescribed more often than FIT squats, the differences between modes of training should be explored to provide practitioners with a relative comparison. The purpose of this study was to examine the differences in load-velocity characteristics between traditional and FIT squats.

Methods

- 18 resistance-trained individuals, including ten men (age = 24.5 ± 3.8 years, height = 173.3 ± 7.5 cm, body mass = 79.3 ± 11.4 kg, relative one repetition maximum [1RM] back squat = 1.95 ± 0.30 kg/kg) and eight women (age = 23.0 ± 3.8 years, height = 167.6 ± 7.5 cm, body mass = 71.5 ± 11.4 kg, relative 1RM back squat = 1.43 ± 0.30 kg/kg) completed three testing sessions
- The first session was used to determine the 1RM back squat and to familiarize the subject with FIT squats.
- The following two sessions required the subjects to perform sets of either traditional back squats with 40, 50, 60, 70, and 80% of their 1RM or FIT squats with inertial loads of 0.010, 0.025, 0.050, 0.075, and 0.100 kgm^2.
- Mean (MBV) and peak barbell (PBV) velocity of the propulsion phase of each squat repetition were captured using a linear position transducer attached to the barbell (traditional) or a PVC pipe (FIT) positioned on the subjects' upper back
- Three squat repetitions at each load were measured and the average performances were used for statistical comparison.
- Two, 2 (mode) x 5 (load) repeated measures ANOVA were used to compare the differences in MBV and PBV of traditional and FIT squats.
- Hedge's g effect sizes were calculated to determine the magnitude of the differences between squat conditions.

Results

Table 1. Traditional and flywheel inertial squat mean (MBV) and peak barbell velocities (PBV).

Traditional		
Load (% 1RM)	MBV (m/s)	PBV (m/s)
40	0.94 ± 0.13	1.53 ± 0.17#
50	0.86 ± 0.10*	1.43 ± 0.15#
60	0.75 ± 0.09*	1.31 ± 0.14#
70	0.63 ± 0.09*	1.19 ± 0.14#
80	0.50 ± 0.08	1.09 ± 0.13#
Flywheel		
Load (kgm^2)	MBV (m/s)	PBV (m/s)
0.010	0.92 ± 0.17	1.40 ± 0.25
0.025	0.77 ± 0.15	1.18 ± 0.22
0.050	0.62 ± 0.13	1.02 ± 0.22
0.075	0.53 ± 0.13	0.91 ± 0.24
0.100	0.48 ± 0.11	0.83 ± 0.23

% 1RM = percent of one repetition maximum back squat; * = significantly greater than flywheel MBV at the corresponding load ($p < 0.001$); # = significantly greater than flywheel PBV at the corresponding load ($p < 0.02$)

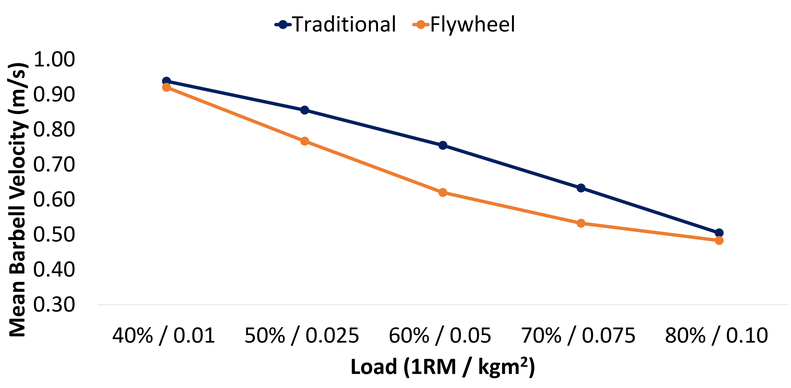

Figure 1. Traditional and flywheel mean barbell velocity load-velocity profiles.

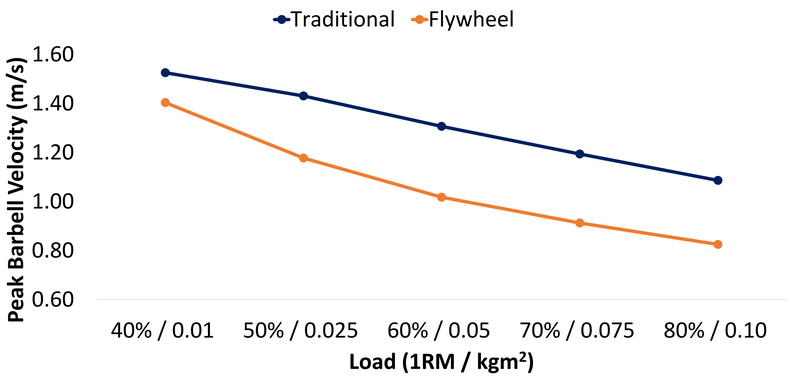

Figure 2. Traditional and flywheel peak barbell velocity load-velocity profiles.

Conclusions

- MBV was significantly greater during traditional squats compared to FIT squats at the 50% 1RM / 0.025 kgm^2, 60% 1RM / 0.050 kgm^2, and 70% 1RM / 0.075 kgm^2 loads and the differences were moderate (g = 0.68-1.15) in magnitude.
- PBV was significantly greater during traditional squats compared to FIT squats across all the load combinations examined and the differences were small at 40% 1RM / 0.010 kgm^2 (g = 0.57) but large across the remaining load combinations (g = 1.30-1.54).

Practical Applications

- Although there were differences between traditional and FIT squats, the use of standardized FIT sizes prevented the loads from being relative to each subject; therefore, it is likely that these wheel sizes do not mimic the same relative loads for traditional squats.
- Practitioners using MBV and PBV to prescribe loads and monitor resistance training should ensure that specific velocity zones are used based on the type of squats that are being performed.

References

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