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

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## 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 (4). Since heavier loads can increase force production during jumping (4), weighted jumps, such as the barbell squat jump (SJ), have popular resistance exercises for developing muscular power. Previous research has shown differences in the force production characteristics of the SJ between different loads (1-3). Despite these findings, no research has compared the force production characteristics of stronger and weaker individuals. Because relative strength can have a significant impact on power output (4), the purpose of this study was to compare the force-time characteristics of the barbell SJ 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 SJ testing session.
- During the SJ testing session, each subject performed two unloaded SJ repetitions and with 20, 40, 60, 80, or 100% of their BM on a force platform.
- Each SJ repetition was performed from a static starting position with the traditional barbell resting on the boxes. 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.** Barbell squat 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 ± 1.5 | 8.6 ± 1.0 | 0.17 | 0.31 ± 0.03 | 0.33 ± 0.03 | 0.43 | 213 ± 44.8 | 221.2 ± 21.7 | 0.24 |
| 20 | 9.8 ± 1.5 | 10.1 ± 1.3 | 0.20 | 0.30 ± 0.03 | 0.30 ± 0.03 | 0.01 | 234.4 ± 52.6 | 241.2 ± 25.5 | 0.17 |
| 40 | 10.1 ± 1.3 | 9.9 ± 1.4 | 0.17 | 0.32 ± 0.03 | 0.33 ± 0.04 | 0.28 | 257.3 ± 55.2 | 258.1 ± 28.1 | 0.02 |
| 60 | 9.7 ± 1.6 | 9.6 ± 1.5 | 0.08 | 0.36 ± 0.03 | 0.36 ± 0.05 | 0.13 | 271.7 ± 59.1 | 271.3 ± 28.7 | 0.01 |
| 80 | 9.3 ± 1.7 | 9.1 ± 1.6 | 0.07 | 0.38 ± 0.04 | 0.39 ± 0.06 | 0.18 | 277.4 ± 57.8 | 279.5 ± 28.4 | 0.05 |
| 100 | 8.5 ± 1.6 | 8.6 ± 1.6 | 0.03 | 0.42 ± 0.05 | 0.43 ± 0.08 | 0.16 | 279.9 ± 57.0 | 286.7 ± 28.0 | 0.16 |

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 SJ.

## Conclusions

- There were no differences in SJ performance regarding MF, Dur, or IMP between stronger and weaker resistance-trained men.
- The prescribed load can have a significant impact on SJ performance; however, the differences may vary in magnitude depending on the load range.

## Practical Applications

- Stronger and weaker men may receive a similar training stimulus when using the SJ with percentages of BM.
- Practitioners should however be aware of the limitations of using percentages of BM for loading purposes.

## References

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