# RELATIONSHIPS BETWEEN COUNTERMOVEMENT JUMP FORCE-TIME CHARACTERISTICS AND 500-METER SPRINT TIME IN SPEED SKATERS

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## Introduction

The 500-m event is the shortest distance of the long-track speed skating disciplines, whereby two skaters per heat compete on a 400-m oval. Like off-ice sprinting competitions, speed skating results are based upon completing a specific distance in the shortest possible duration. While off-ice training may benefit speed skating initial sprint performance (1,4), less is known about how the force-time characteristics of speed skaters relates to their sprint performance. The countermovement jump (CMJ) is one of the most common performance assessments within athlete testing batteries. McMahon and colleagues (3) indicated that the braking and propulsion phases of the CMJ are useful tools to understand how an athlete produces vertical force to stop their downward momentum before propelling themselves vertically. Given the need to generate large magnitudes of force within short durations to accelerate during a 500-m on-ice sprint (2), it would seem logical that CMJ braking and propulsion force-time characteristics would relate to 500-m sprint time of speed skaters. Therefore, the purpose of the current study was to examine the relationships between CMJ braking and propulsion force-time characteristics and 500-m sprint time in national and international level speed skaters. It was hypothesized that CMJ force-time characteristics would relate to on-ice 500-m sprint time in national and international level speed skaters.

## Methods

- 9 male (21.0 ± 2.6 years, 77.9 ± 10.1 kg, 179.9 ± 8.8 cm) and 10 female (20.8 ± 4.4 years, 64.9 ± 5.1 kg, 167.9 ± 3.6) 500-m national and international level speed skaters performed two CMJ trials one week before the 2022 Olympic Trials.
- Participants performed self-selected dryland warm-up prior to completing warm-up jump trials at 50 and 75% of their perceived maximum effort.
- Two maximal CMJ trials were performed with the subjects' arms akimbo on dual Pasco force plates (PASCO Scientific, Roseville, CA).
- Force-time data were exported to and analyzed using a custom spreadsheet (Microsoft, Redmond, WA).
  - Variables included CMJ height, braking mean force, peak force, and duration and propulsion mean force, peak force, and duration.
- 500-m times were obtained from the Olympic Trials one week after CMJ assessments.
- The average performance between CMJ trials was used to examine the relationships of each variable and the 500-m sprint time.
- Pearson correlation coefficients (r) and coefficients of determination ($R^2$) were used to examine the relationships between CMJ force-time characteristics and 500-m sprint time.

## Results

**Table 1**. Countermovement jump force-time characteristics.

| | JH (m) | BMF (N·kg$^{-1}$) | BPF (N·kg$^{-1}$) | BDur (s) | PMF (N·kg$^{-1}$) | PPF (N·kg$^{-1}$) | PDur (s) | 500-m (s) |
|---|---|---|---|---|---|---|---|---|
| **Mean** | 0.38 | 17.7 | 23.9 | 0.19 | 19.2 | 24.3 | 0.30 | 39.42 |
| **±** | ± | ± | ± | ± | ± | ± | ± | ± |
| **SD** | 0.08 | 2.3 | 3.0 | 0.03 | 1.8 | 2.6 | 0.03 | 3.08 |
| **r** | 0.885** | -0.384 | -0.546* | 0.361 | 0.763** | 0.683** | 0.533* | - |

Note: r values relate to 500-meter times. JH = jump height; BMF = braking mean force; BPF braking peak force; BDur = braking duration; PMF = propulsion mean force; PPF = propulsion peak force; PDur = propulsion duration; * = significant at 0.05 level; ** = significant at 0.01 level

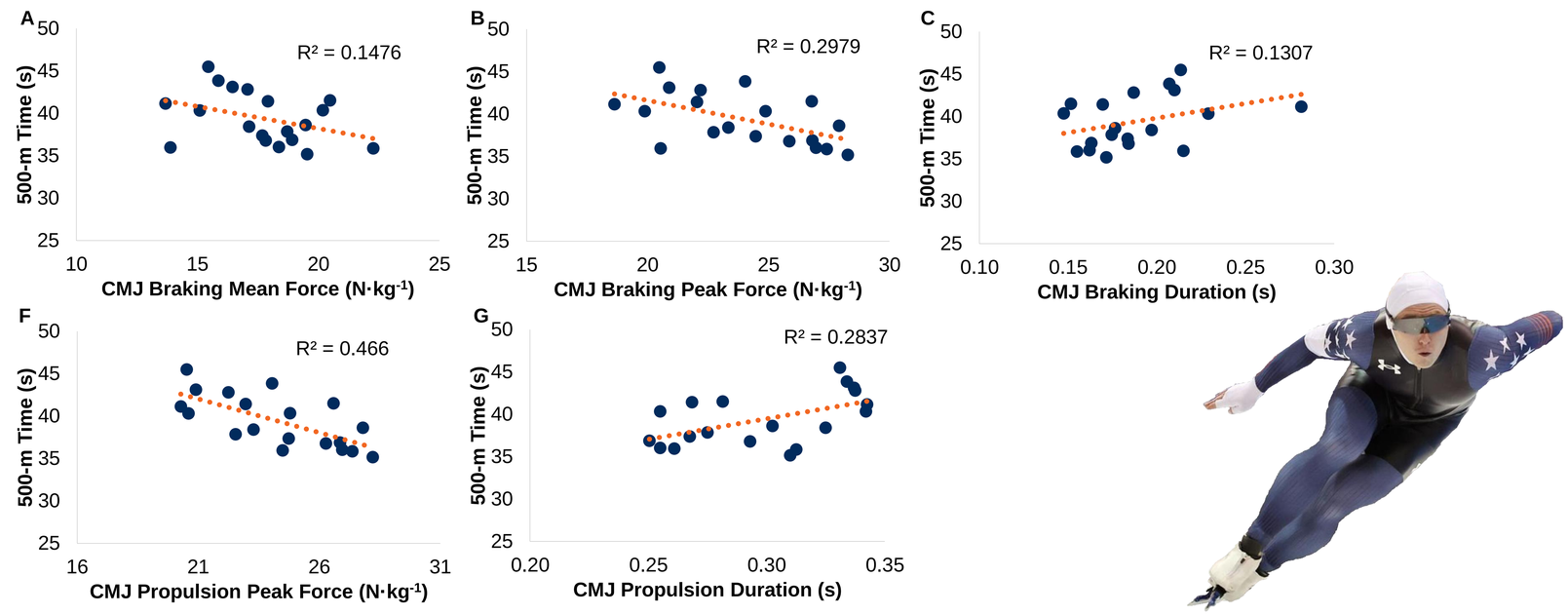




**Figure 1**. Relationships between 500-m sprint time and countermovement jump (CMJ) braking mean force (A), braking peak force (B), braking duration (C), height (D), propulsion mean force (E), propulsion peak force (F), and propulsion duration (G).

## Conclusions

- Very large relationships existed between CMJ height and propulsion mean force and the 500-m sprint times in national and international level speed skaters.
- A large portion (78.3%) of the 500-m time variance was explained by CMJ height indicating the potential to use this variable to monitor a speed skater's performance.
- It is also important to develop the propulsive strength characteristics of speed skaters given that 58.2% of the 500-m time variance was explained by propulsion mean force.
- CMJ braking characteristics do not appear to be effective monitoring variables for speed skaters due to only small portions of 500-m sprint time variance being explained.

## Practical Applications

- Strength and conditioning practitioners may consider using CMJ height as a monitoring variable with short distance speed skaters.
- It is evident that maximizing a speed skater's propulsive strength characteristics (i.e., peak force and rapid force production) may positively impact speed skating sprint performance.
- Practitioners should implement dryland and resistance training strategies to benefit these characteristics.

## References

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National Strength and Conditioning Association National Conference
Las Vegas, NV July 12 – 15, 2023

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