Short Communication

A short communication on the relationships between the barbell hip thrust and change-of-direction speed in college-aged women

Robert G. Lockie, Ashley J. Orjalo, Samuel J. Callaghan

Objectives: To determine the relationships between the one-repetition maximum barbell hip thrust (1RM BHT) with change-of-direction (COD) speed measured by the 505 in college-aged, recreationally-trained women.

Design and Methods: Twenty college-aged women completed two testing sessions. In session 1, participants completed a 1RM BHT to measure absolute and relative lower-body strength, with an emphasis on the hip extensors. In Session 2, participants completed four trials (two per leg) of the 505 COD speed test. The mean of the two trials per leg was analyzed; the leg with the fastest 505 time was termed the dominant leg. Pearson's correlations ($p < 0.05$) and regression scatter plots were used to calculate relationships between absolute and relative BHT strength and the 505 measured from the dominant and non-dominant leg.

Results: There were significant relationships between relative strength measured by the 1RM BHT and the 505 from the dominant ($r = -0.473$, $p = 0.035$) and non-dominant ($r = -0.452$, $p = 0.046$) legs, with ~21-22% explained variance. There were no significant relationships between absolute BHT strength and the 505 ($r = -0.291$ to -0.309, $p = 0.184$-0.213).

Conclusions: Relative maximal hip extensor strength could be an important contributor to faster COD as measured by the 505 in college-aged, recreationally-trained females. The correlation strength and explained variance indicates that there are likely other factors beyond relative strength measured by the BHT that would contribute to a faster 505. Nonetheless, the results of this short communication provide support for developing hip extensor strength in females, as this could benefit COD speed in actions similar to those in the 505.

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Key words: 505 ■ cutting ■ dominant and non-dominant legs ■ females ■ hip extension ■ lower-body strength

INTRODUCTION

Agility has been defined as an action that features an initiation of body movement, change-of-direction (COD), or rapid acceleration or deceleration in response to a stimulus, and is an essential quality for many athletes at all levels of play.[13] COD speed is a foundation of agility and incorporates the physical factors, including the athlete's sprint technique, strength, and power.[13] Lower-body strength can contribute to an enhanced ability to tolerate and generate the forces associated with deceleration and acceleration during a cut.[15] It is important for practitioners to select exercises that could concurrently improve strength and COD speed to enhance training efficiency. This is especially important for female athletes from all levels, who may not have the training exposure or access to facilities.[8]

There has been some analyses of the relationships between strength and COD speed in females with different athletic backgrounds. Nimphius et al.[12] found relative strength measured by an estimated one-repetition maximum (1RM) back squat correlated ($r = -0.50$ to -0.85) with the 505 performed from both legs in softball players. Spiteri et al.[17] found significant relationships between dynamic (back squat), concentric and eccentric (half squat), and isometric (mid-thigh pull) strength with the 505 and T-test in elite basketball players ($r = -0.792$ to -0.892). Tramel et al.[19] found correlations between relative strength measured by an estimated 1RM hexagonal bar deadlift and the 505 (right leg $r = -0.689$; left leg $r = -0.743$) and modified T-test ($r = -0.840$) in Division II collegiate volleyball players. Interestingly, Tramel et al.[19] found absolute strength only related to the modified T-test ($r = -0.728$) and not the 505 ($r = -0.566$ to -0.606). These studies show the value of lower-body strength, especially relative strength, as a contributor to COD speed in females.[12,17,19] However, there has been limited analyses of horizontally-loaded exercises, with one example being the barbell hip thrust (BHT).

The BHT involves placing a barbell above the pelvis while the individual is seated on the ground with their upper-back supported on a bench. From here, the individual lifts their hips from the ground and performs a forceful hip extension.[3] This exercise targets the hip extensors (gluteus maximus, biceps femoris), with the quadriceps also active.[1,4] These muscles are essential for an effective COD, as they absorb force during deceleration,[10] and project the body during accelera-

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From the Center for Sport Performance, Department of Kinesiology, California State University, Fullerton, Fullerton, CA, USA (R.G.L., A.J.O.) and Centre for Sports and Exercise Science Research, School of Medical and Health Sciences, Edith Cowan University, Joondalup, Australia (S.J.C.)

Communicated by Takashi Abe, PhD

Correspondence to: Dr. Robert Lockie, Department of Kinesiology, California State University, Fullerton, 800 N State College Blvd, Fullerton, CA 92831, USA. Email: rlockie@fullerton.edu

tion.[10,14] Training with the BHT could be beneficial to enhancing COD speed in trained individuals.[20] If the BHT is already in use,[4,20] it would be beneficial to understand how it may relate to more dynamic actions such as COD speed specific to females. Females of all athletic abilities require more specific analysis, including analyzing relationships between an exercise like the BHT and COD speed. This could directly influence the training adopted by females to enhance athletic performance.

The purpose of this short communication was to investigate the relationships between the 1RM BHT with COD speed as measured by the 505 in recreationally-trained females. Despite the popularity of the BHT,[4,6] there has been limited analysis of it within the scientific literature. The 505 was selected as it can isolate COD ability from one leg, and the 180º direction change features in many sports.[11]

METHODS

Experimental Approach to the Problem

A cross-sectional analysis of college-aged females performing the 1RM BHT and 505 was conducted. The BHT was analyzed as it is a popular strength exercise,[3,4,20] while the 505 is a standard test of COD speed.[11] Pearson's correlations calculated relationships between the BHT and 505.

Participants

Twenty recreationally-trained females (22.60 ± 2.21 years; height: 1.63 ± 0.06 m; body mass: 65.54 ± 8.92 kg) completed this study. Participants were recruited if they: were college-aged (18-30 years); had a resistance training age of at least one year and were experienced with the BHT and actions required in the 505; and were free from any lower-extremity injuries that could influence participation. The institutional review board approved the study (HSR-18-19-229), all participants received a clear explanation of the procedures, and written informed consent was obtained.

Procedures

Participants completed two testing sessions separated by 48-72 hours. On day one, participants had their age, height, and body mass recorded. Height was measured using a stadiometer (Detecto, Webb City, MO), while body mass was measured via electronic scales (Ohaus, Parisppany, NJ). A standardized warm-up of 5 min of jogging at a self-selected pace on a treadmill and 10 min of dynamic stretching was completed on both testing days. Session 1 involved testing of the 1RM BHT; session 2 involved the 505 testing.

One-Repetition Maximum Barbell Hip Thrust (1RM BHT)

To perform the BHT, participants started by sitting on the ground with their legs flat on the floor, feet shoulder-width apart, and their upper back against a padded exercise bench. A standard Olympic barbell and weight plates (Diamond Pro, Decatur, AL), with a pad positioned on the bar for comfort,[3] was placed above their lower legs, slightly below the knees. The participant then positioned the barbell above their pelvis, and assumed the start position by bringing their heels toward the bench by flexing the knees. Participants then lifted their hips until their knee joint created a 90° angle with a vertical tibia. They held this position for 1 s before lowering the barbell in a controlled manner.[3] Regarding reliability, BHT peak force, which is related to the 1RM, has intra-class correlation coefficients (ICC) of 0.94-0.99.[5]

After the dynamic warm-up, the participant completed warm-up sets consisting of 3 sets x 8 repetitions at 30%, 40%, and 50% of the participant's perceived 1RM, with 2 min between-set rest.[6] After the warm-up sets, a load equivalent to ~90-95% of the participant's perceived 1RM was placed on the bar, and the participant completed a single repetition. The weight was increased by ~5% and participants completed single repetitions until the 1RM was attained.[9] Three min rest was provided between attempts, and the 1RM was generally attained within 5 attempts. For a successful repetition, the BHT had to be completed with good form (the knee joint reached a 90° angle with a vertical tibia).[6] Absolute strength was the 1RM load lifted; relative strength ($kg \cdot BM^{-1}$) was calculated via $1RM \cdot body\ mass^{-1}$.[9] The 1RM value was used as it is a standard measure of strength,[9] and strength measures derived from 1RM values been related to athletic performance.[12,17,19]

505 COD Speed Test

The 505 incorporates a 180° turn in between two 5-m sprints (Figure 1).[2,11] Previous research has detailed the reliability of this test (ICC = 0.88-0.97).[2,18] Furthermore, the 505 should be specifically analyzed in females as it isolates COD for each leg, limits linear sprinting compared to other COD tests (e.g. the pro-agility shuttle), and incorporates a movement that corresponds to many sports.[11] The participant began at the start line and accelerated through a timing gate (Brower Timing Systems, Draper, Utah) to the turning line indicated by a line marked on the ground and markers. Depending on the trial, the left or right foot was placed on or behind the turning line, before the participant performed a 180° direction change and sprinted back through the gate. Similar to previous research, the leg that was tested first was the participant's preferred cutting leg.[2] Two trials were performed consecutively, before participants rested for 2.5 min and completed another pair of trials. The mean of the trials for each leg analyzed, and the leg with the fastest time was termed the dominant leg.

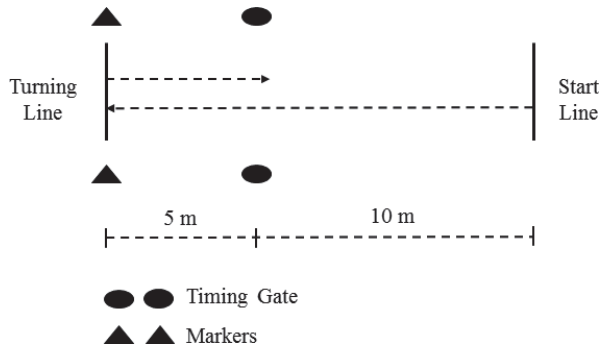

Figure 1 Structure of the 505 test.

Statistical Analysis

Statistics were computed using the Statistical Package for Social Sciences Version 25.0 (IBM, Armonk, United States of America). Descriptive statistics (mean ± SD) were used to profile the 1RM BHT and 505 data. ICCs were calculated for the 505 trials to assess reliability. Pearson's correlations ($p < 0.05$) were used to calculate relationships between the 1RM BHT and 505 from both legs. The correlation strength was designated as: an r between 0 to ± 0.3 was small; ± 0.31 to ± 0.49, moderate; ± 0.5 to ± 0.69, large; ± 0.7 to ± 0.89, very large; and ± 0.9 to ± 1 near perfect for relationship prediction.[7] Microsoft Excel (Microsoft Corporation™, Redmond, Washington, USA) was also used to produce regression scatter plots for significant 1RM BHT relationships with the 505.

RESULTS

Participants had a mean 1RM BHT of 113.83 ± 39.27 kg, and mean relative strength value of 1.76 ± 0.62 kg·BM^{-1}. The mean 505 times were 2.96 ± 0.17 s and 3.04 ± 0.18 s for the dominant and non-dominant legs, respectively; the ICC was 0.976. The absolute 1RM BHT did not significantly relate to the 505 from the dominant (r = -0.309, p = 0.184) or non-dominant (r = -0.291, p = 0.213) legs. Relative strength did significantly relate to the dominant (r = -0.473, p = 0.035) and non-dominant leg (r = -0.452, p = 0.046) 505 times. Greater relative strength was associated with faster 505 times. Scatter plots were produced for the relative strength relationships (Figure 2). There was 22% and 21% explained variance with the dominant and non-dominant leg 505 times, respectively.

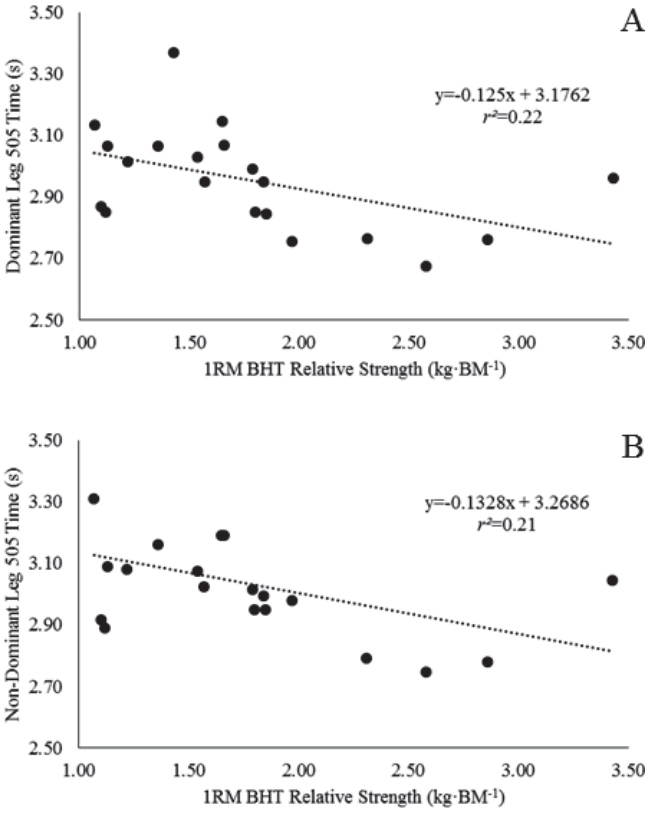

Figure 2 Scatter plots indicating the relationship between relative strength measured by the 1RM BHT with the 505 from the dominant (A) and non-dominant (B) legs.

DISCUSSION

This short communication investigated the relationships between absolute and relative strength measured by the 1RM BHT and 505 performance from the dominant and non-dominant legs. It should be noted that the analysis involved recreationally-trained females, so the findings may not readily crossover to elite populations. Nonetheless, the results indicated that greater relative strength derived from the 1RM BHT significantly correlated with faster 505 times from both legs. Notably, absolute 1RM BHT strength did not. For greater translation to COD speed, the data from this study suggests practitioners should ensure females can express high relative lower-body strength specific to the hip extensors for enhanced COD speed.

Previous research has demonstrated that greater relative strength measured by the back squat[12] and hexagonal bar deadlift[19] correlated with faster 505 performance in female athletes. The current results supported these findings. However, the novel aspect from this study was the use of the 1RM BHT as the strength test. Similarities in the muscles required to generate force in the BHT,[1,4] and during a COD,[10,14] likely contributed to the relationships found. For example, the gluteus maximus is recruited in the BHT,[4] and generates propulsive force during acceleration.[10,14] These results provide support to the use of the BHT to potentially enhance COD speed via increased hip extensor strength.

Absolute 1RM BHT load did not significantly relate to 505 times from either leg. Tramel et al.[19] also found that absolute strength measured by an estimated 1RM hexagonal bar deadlift did not significantly relate to the 505. Taken together, the current data and that from Tramel et al.[19] reinforces the need for female athletes to specifically develop relative strength. The ability to COD quickly involves the individual effectively overcoming the inertia of their body mass, which lends more towards relative force production and strength rather than absolute. Especially as it pertains to COD speed measured by the 505, it may not be enough for females to just develop a high amount of absolute force; they must be able to develop high force relative to body mass.

It should be noted that the relationships between relative BHT strength and 505 times were moderate, with an explained variance of ~21-22%. This suggests that there are other qualities important for COD speed in females. These results are not unexpected, as lower-body power, COD technique, and linear speed can also contribute to COD speed.[13,16] Future research should incorporate not only the BHT as a measure of hip extension strength, but other tests of physical qualities that could contribute to faster 505 performance. This could more clearly note other contributing factors to COD speed in females. Nonetheless, the results from this short communication highlights the potential importance of relative hip extensor strength measured by the BHT for COD speed featuring actions similar to those required in the 505.

CONCLUSION

The data indicated that there were significant relationships between relative strength derived from the 1RM BHT and 505 times performed from both legs in recreationally-trained females. These relationships likely existed due to the recruitment of similar muscles important for both the BHT and a 180° COD. Although the strength of the relationships did suggest other contributing factors (e.g. lower-body power, COD technique), the results are still notable. If recreationally-trained females develop their relative hip extensor strength as measured by the BHT, this could positively influence COD speed in actions similar to those present in the 505.

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CONFLICT OF INTEREST

This research project received no external financial assistance. None of the authors have any conflict of interest.

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