ANTHROPOMETRICAL DETERMINANTS OF DEADLIFT VARIANT PERFORMANCE

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INTRODUCTION: The barbell deadlift is a popular exercise employed to increase the strength of the posterior kinetic chain in athletes, recreational weight lifters, and the elderly (Thompson et al., 2015). The barbell deadlift is also one the three lifts tested during competition in competitive power lifting. The barbell deadlift is performed with two different styles: conventional and sumo. According to the United States Powerlifting Association, overall deadlift records have been by both men and women in various weight classes when using both lifts ("National Records," 2016). While differences in muscle activation and biomechanics have been studied between the two styles with minimal differences in EMG readings in the lower limbs or hip extension range of motions reported in 3D analysis (Escamilla et al., 2000; Escamilla et al., 2002), and conversations with competitive lifters demonstrate a clear preference for one style over another, little is known about the anthropometrical determinants of deadlift performance between the two styles. This work is part of a larger, ongoing, study intended to: (1) identify relationships between anthropometrics and overall deadlift performance; (2) investigate the interaction between limb and height ratios and differences in performance between the conventional and sumo style deadlifts in untrained individuals; and (3) improve individualized resistance training exercise prescription. The purpose of this data is to investigate the relationships between anthropometrics and overall deadlift performance.

METHODS: Thirty-five deadlift naïve recreationally trained subjects (ht: 174.3±8.9 cm; wt: 76.8±16.8 kg; age: 21.7±3.0 years; training experience 9.2±10.2 months) without any existing musculoskeletal disorders, free from consumption of anabolic steroids or any other illegal agents known to increase muscle size within the past year, and not be currently engaged in a structured deadlift training program participated in this study. All subjects read and signed an informed consent document, which were approved by the Coastal Carolina University's Institution Review Board, and only the subjects that completed all four testing days (Table 1) were included in the final analysis.

Anthropometrics: Height was measured using standard anthropometry (stadiometer) and body mass was measured using a calibrated scale. All limb lengths were measured with a tape measure. Upper arm length was measured as the distance between the acromion process and the olecranon process. Forearm length was the distance between olecranon process and the radial styloid process. Wrist girth was the minimal circumference measured distal the radial styloid process. Hand length was the anterior surface of the hand as the distance between the scaphoid carpal and distal tip of the third distal phalange. To measure seated height subjects sat on an adjustable unpadded stool set to a height that places the hips and knees at 90 degrees of extension. The distance between the top of the head and the chair was recorded. Upper leg length was the distance between the superior border of the greater trochanter and the lateral tibial condyle. Lower leg length was recorded as the distance between the lateral tibial condyle and the bottom of the foot (the floor). Finally, ankle girth was the minimal girth measurement of the region just superior to the malleoli.

Performance Measurements:

Vertical Jump was assessed on day 2 by performance during a countermovement jump (CMJ) as assessed by Just Jump! Mat (Probotics Inc.: Huntsville, AL). The best of three attempts separated by at least 1-minute of rest was recorded.

Abdominal Strength-Endurance was measured on day 2 via maximal repetitions performed in the crunch exercise. Subjects were instructed to lie in the supine position with the head flat against a mat subjects with hips and knees flexed to 90 degrees. Subjects crunched using their abdominals until all thoracic vertebrae were off the mat. A tempo of 2 sec concentric and 2 second eccentric was used.

Deadlift 1 Repetition Maximum was conducted on days 3 and 4 according to the recognized guidelines as established by the National Strength and Conditioning Association (Baechle & Earle, 2008). Three to 5-minutes rest was provided between each successive attempt and all determinations were made within 5 attempts. If subjects could no longer lift the weight while maintaining a neutral spine the test was terminated and the highest load lifted was recorded.

Deadlift Repetitions to Fatigue (DRF) was conducted on days 3 and 4 following 5 min of rest following the 1 RM. The load used corresponded to 60% of the 1 RM from the session 3 deadlift 1 RM. Subjects performed as many repetitions as possible with a 1-2 second concentric and 1-2 second eccentric tempo. The test was terminated when subjects could longer perform the exercise with proper deadlift technique and a neutral spine.

Deadlift Technique: In the first session subjects were taught to perform a hip hinge in the conventional and sumo positions by standing approximately 20 cm with their backs facing a wall. For the conventional position subjects stood with feet hip width apart and for the sumo the feet were wider than shoulder width with the toes pointing outwards. Once subjects demonstrated proficiency in the hip hinge they were instructed to perform the conventional and sumo style deadlifts using an unweighted PVC plastic pipe. The PVC pipe was placed on blocks that elevated the pipe to the standard Olympic-plate deadlift starting position (22.5 cm). In the second session, subjects began by practicing the conventional and sumo style deadlifts with the pipe off the blocks following the testing of the CMJ and abdominal crunch. Once subjects had demonstrated proficiency in technique they were progressed to practicing with an Olympic weight lifting bar (20 kg) for one set of 6 repetitions. Subjects performed sets of 2, and the load was progressed by 5-20 kg per set until subjects rated the set as a load they felt they could only perform for 6-8 repetitions. This load was recorded and used as the first 1 RM attempt during subsequent 1RM testing. Sessions 3 and 4 were randomized and contained the 1 RM and repetitions to failure tests for either the conventional or sumo style deadlift.

Statistical Analysis: All descriptive data is reported as the mean ± standard deviation. The data did not violate any assumptions of normality, multicollinearity, or bias. To determine significant differences between 1 RM and DRF, a paired samples t-test was used. Pearson correlations was used to assess relationship between anthropometrical measures, training experience, vertical jump, crunch, and DRF, and 1 RM conventional and 1 RM sumo deadlift strength. A stepwise forced entry/Enter multiple regression model was chosen since there has been no prior research establishing which predictors should go first in a hierarchical model. The dependent variables were the conventional and sumo deadlift 1 RM, and the predictors used for prediction were the anthropometric measurements, vertical jump height, and crunch performance. Statistical significance was set at $p \leq 0.05$ and all data was analyzed using the SPSS 22.0.

RESULTS: There were no significant (p>.05) differences between conventional 1RM (117.3±35.4 kg) and sumo 1RM (118.0±34.8 kg). Significant positive correlations between all anthropometrics and performance variables were found for both the conventional 1 RM and sumo 1 RM. A significant negative correlation was found between the DRF and 1RM for both styles. Training experience and crunch performance did not significantly correlate with either 1RM (Table 2). The regression was not significant ($F(13,19)=1.11$, p>.05), with an R^2 of .432.

DISCUSSION: Deadlift strength in both the conventional and sumo style was found to correlate positively with all anthropometrics and jumping performance with very similar correlation coefficients regardless of style. Deadlift strength-endurance was negatively related to 1RM deadlift performance across both styles. It is possible individuals with more training experience could lift more weight, possibly due to better motor mechanics; however, although there was a correlation between training experience and 1RM, there were no correlations between training experience and DRF. The results of the multiple regression analysis demonstrate that none of the predictors chosen were useful at predicting whether an individual will perform better in the conventional or sumo deadlift. Ultimately, we found that individuals with larger frames, as indicated via greater anthropometrical measurements, can deadlift more weight. In conclusion, the results of this study suggest that deadlift style preference and performance is most affected by training history, and as such, coaches and lifters should select a style based upon individual preference and past performances.

Ongoing analysis of this data will be required to investigate the impact of relative frame size indicators, such as the ratio between femur and total leg length, or sitting height and total height. Given that the demands placed upon the lumbar extensors are approximately 10% greater in the conventional compared to the sumo deadlift (Cholewicki, McGill, & Norman, 1991), we hypothesize that individuals with longer relative torsos perform better with the sumo deadlift.

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