THE EFFECT OF LOAD SCALING ON THE COORDINATION AND PERFORMANCE OF COUNTERMOVEMENT JUMPS

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INTRODUCTION

In recent years, numerous studies have been conducted using dynamic systems theory (DST) as a means to examine kinematics and stability in human movement patterns. While the performance aspects of the countermovement jump have been studied heavily [1,2], the effect of load scaling on the coordination of the jump squat movement is currently unknown. It is likely that the changes in jump squat performance are mirrored by changes in jump squat coordination. Therefore, the purpose of this project was to assess the coordination and performance of the jump squat movement for multiple loading conditions using the principles of DST.

METHODS

This study involved seventeen male participants ranging in age from 18 to 30 years (mean age 21.1 ± 2.6 years). The mean body mass was 94.5 ± 18.2 kg while the mean body height was 1.78 ± 0.06 m. All participants were free of lower body injury at the time of data collection. Each participant was required to undergo an initial familiarization session which was utilized to determine the participants' three repetition maximum (3 RM) for the squat movement. That 3 RM value was then used to predict the one repetition maximum (1 RM) which was necessary to establish the amount of weight required for each loading condition during the jump squat testing session. For that actual testing session, two jump squats were performed for each loading condition, 0-60% of each participants' 1 RM incremented by 10% for each trial. Two-dimensional video capture was used to assess kinematics and a force platform in combination with a linear position transducer was used to determine power.

RESULTS AND DISCUSSION

Regardless of the participants' strength background, the power output values decreased as the applied load was increased from 0-60%. No difference was found in the power values achieved during the lower loading percentages of 0-20%, which is significant because all but two participants reached their peak power by 20% of their 1 RM value. This finding indicates that peak power is produced with little to no applied load. The mean power values for all participants can be observed in Table 1.

However as the power outputs were decreasing, the mean absolute relative phase (MARP) values for the shank-thigh and thigh-trunk relationships were increasing. This increase in MARP signifies that a more out-of-phase relationship was occurring between segments and two segments working in greater opposition indicates that a change in coordination is taking place. The MARP values calculated from 0-30% were found to be statistically similar and can be identified as the more highly coordinated jump squat trials. The values achieved above 30% of 1 RM, confirm that as the applied load was increased that the participants' were shown to deviate from their normal jump squat movement pattern. The mean MARP values can also be found in Table 1.

CONCLUSIONS

More highly coordinated movement patterns and greater power output values were found to occur at lower percentages of load (0-30%). The lack of change observed from 0-30%, indicates that the participants were efficient in carrying out the jump squat movement at those percentages and that the movement pattern observed was the preferred pattern of motion. Since the results established for the unloaded condition were consistent with those found up to and including 30%, it can be concluded that jump squat performance was stable throughout that range of 1 RM percentages. On the whole, these results indicate that optimal jump squat performance is achieved at lower loading percentages and also suggest the existence of a relationship between power output and coordination.

REFERENCES

1. Wilson, G.J., et al. Medicine Science Sports Exercise, **25**(11), 1279-86, 1993.
2. Stone, M.H., et al. Journal of Strength and Conditioning Research, **17**(1), 140-147, 2003.

Table 1: The mean and standard deviation values of the power outputs and MARPs calculated for all participants.

Loading Percentage	Power Output (Watts)	Shank-Thigh MARP	Thigh-Trunk MARP
0	5521.00 ± 1346.83	100.47 ± 14.92	97.70 ± 6.38
10	5631.42 ± 1366.34	98.94 ± 12.61	97.84 ± 6.03
20	5536.93 ± 1250.01	102.91 ± 13.93	97.55 ± 5.06
30	5353.10 ± 1161.52	102.07 ± 11.75	97.56 ± 4.95
40	5232.36 ± 1183.10	105.42 ± 10.41	101.03 ± 5.21
50	4981.22 ± 1177.06	105.82 ± 14.48	101.78 ± 6.08
60	4765.56 ± 979.53	109.79 ± 10.08	102.07 ± 5.47