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Original Article

Acute effects of jumping and sprinting on hammer throwing performance

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Abstract:
Purpose: The purpose of the present study was to investigate the acute effect of counter movement jumping (CMJ) or sprinting on hammer throwing performance in experienced hammer throwers.
Methods: Six well-trained hammer throwers with best performance 61-74m, participated in the study. After standard warm-up they performed three hammer throwing attempts with maximum effort, separated with 1.5-min interval. Three minutes later, they performed three maximal consecutive CMJs. Immediately after the CMJs, they performed three hammer throwing attempts with maximum effort, separated with 1.5-min interval. One week later, they carried out an identical protocol but they performed a bout of 20m sprinting instead of the CMJs, in order to potentiate shot put performance (interventions were counterbalanced). Muscular strength (1RM in squat, snatch, clean and jerk) was also measured.
Results: Hammer throwing performance was significantly increased after CMJs (62.92±4.43m vs. 64.42±5.13m, p=0.047) as well as after 20m sprinting (64.87±3.90m vs. 65.30±4.02m, p=0.013), although the increase in performance was not different between the two interventions (p=0.214).
Conclusions: These results suggest that performing 3 CMJs or one bout of 20m sprint with maximum effort just before hammer throwing may be a useful method for acute increases in performance in experienced hammer throwers.
Key words: postactivation potentiation, warm-up, athletic throws, track and field

Introduction

Athletes competing in track and field throwing events occasionally perform intensive muscular actions immediately before competition in order to acutely increase their performance. However, there are limited scientific data regarding the effectiveness of such interventions. Recently, it was reported that the performance of either 3 consecutive countermovement (CMJ) jumps or 20m sprinting, immediately before competition induce significant acute increases in shot put performance which is probably attributed to the phenomenon of post activation potentiation (Terzis et. al. 2012). Similarly, peak weight-throw performance was enhanced after throwing an implement of 1.37kg or 2.27kg heavier than the competition implement, in young but trained weight throwers (Judge, 2010). In another recent study, it was shown that five consecutive drop jumps induce a significant increase in squat underhand shot put throwing performance, in moderately-skilled subjects and this increase was closely linked with the percentage of type II muscle fibers in vastus lateralis (Terzis et. al. 2009). Hammer throwers have a high percentage of type II fibers (Terzis et. al. 2010). Thus, it is reasonable to hypothesize that explosive muscular actions such as jumping or sprinting, which can be easily performed immediately before a hammer throwing attempt, would enhance hammer throwing performance. The purpose of the present study was to investigate the acute effect of counter movement jumping and sprinting on hammer throwing performance in experienced hammer throwers.

Methods

Subjects

Six male hammer throwers (>6 years training experience, age 26±3years, height 184±2cm, body mass 113.4±15kg) gave their written consent to participate in the study, after being thoroughly informed about the procedures. Individual best performance ranged between 61.14m to 74.90m.

CMJ, sprinting and maximum strength

All experiments were performed on a standard circle during early afternoon. After 20-min warm-up each athlete rested at a sitting position for 5 minutes. Subsequently, each athlete performed three attempts with maximal effort using a 7.260kg implement with 1.5 minute interval between attempts. Athletes then rested for 3 minutes before performing either 3 consecutive CMJ or, on another day, one bout of 20m sprinting. After this intervention (jumping or sprinting), athletes performed another set of 3 throwing attempts with maximum effort

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with 1.5 minute interval between attempts. The time between the completion of the experimental intervention (CMJs or sprinting) and the subsequent hammer throw attempt was 1 minute. The sequence of the interventions (CMJs or sprinting) was counterbalanced. Assessment of maximal strength (1RM) in squat, snatch and clean and jerk was performed on different days, as previously described (Beachle et. al. 2000).

Statistical Analyses

Means ±SD were used to describe variables. Paired T-tests were used to investigate changes in performance before and after the interventions. Pearson's (*r*) product moment correlation coefficient was used to explore the relationships between variables. Significance was set at $P \leq 0.05$.

Results

Hammer throwing performance was significantly increased after the CMJs (before 62.92±4.43m, vs. after 64.42±5.13m, p=0.047, Figure 1). Similarly, hammer throwing performance was significantly increased after sprinting (before 64.87±3.90m vs. after 65.30±4.02m, p=0.013, Figure 2). It is worth noting that all but one athletes managed to increase their performance after either jumping or sprinting. The increase in performance after sprinting was not significantly different compared with the increase after the CMJs (p=0.214). The increase in performance after CMJs and/or sprinting was not correlated significantly with any of the anthropometric or the muscular strength measurements. The percentage increase in hammer throwing performance after either jumping or sprinting was not correlated significantly with the best individual hammer throwing performance.

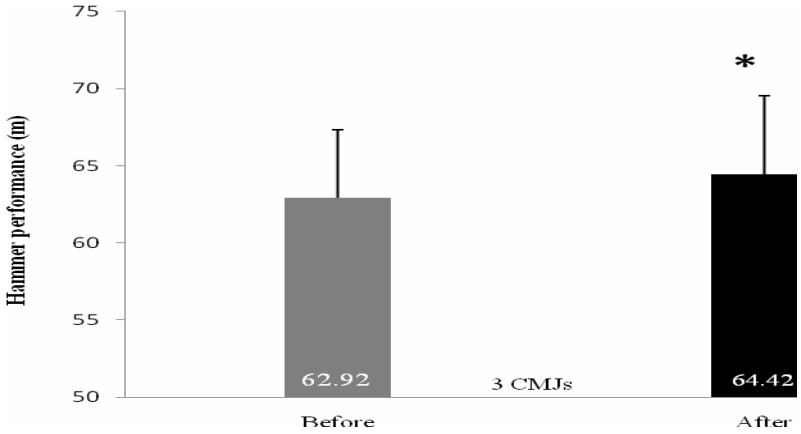

Figure 1. Maximum hammer throwing performance before and immediately after three consecutive counter movement jumps, in experienced hammer throwers (n=6, *=P<0.05).

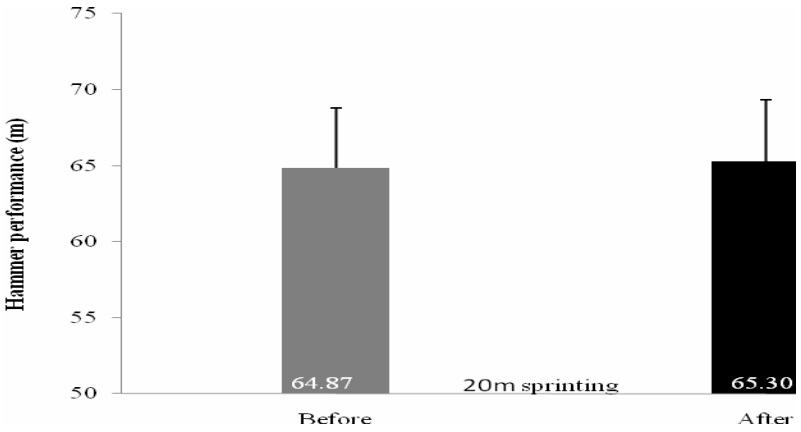

Figure 2. Maximum hammer throwing performance before and immediately after 20m sprinting, in experienced hammer throwers (n=6, *=P<0.05).

Discussion

The main finding of the present study was that hammer throwing performance was significantly increased immediately after performing either three consecutive CMJs or a bout of 20m sprinting in experienced hammer throwers. This result might be attributed to the phenomenon of post-activation potentiation (PAP) which denotes that peak force as well as the rate of force development are enhanced immediately after the

implementation of an intense maximal or near-maximal voluntary contraction (Hamada et. al. 2000a,b; Tillin & Bishop, 2009). This performance enhancement has been attributed to either an enhanced phosphorylation of the myosin regulatory light chains in skeletal muscle fibers and/or an increase in the recruitment of higher threshold motor units (Tillin & Bishop, 2009). Studies in power-demanding activities have shown that intense muscular actions induce an increase in subsequent powerful performance. For example, peak weight-throw performance is enhanced after throwing a heavier implement in young weight throwers (Judge, 2010). Moreover, performing five consecutive drop jumps from 40cm, induces a significant acute increase in throwing performance in moderately trained individuals (Terzis et. al. 2009). Recently, application of a similar PAP protocol to the one utilized in the current study, significantly enhanced performance in experienced shot putters (Terzis et. al. 2012).

In addition, throwing performance seems to preferentially increase in subjects possessing a relatively high percentage of type II muscle fibers in their vastus lateralis(Terzis et. al. 2009). The beneficiary effect of a higher percentage of type II muscle fibers in PAP has been well described before (Hamada et. al. 2000a). Hammer throwers have a relatively higher percentage of type II fibers in their lower body muscles. Indeed, the type II% muscle fiber area in vastus lateralis of three of the current athletes was between 58-67% (Terzis et. al. 2010). Based on these results, it might be speculated that experienced hammer throwers can acutely increase their performance with 3 CMJs or 20m sprint, perhaps because they possess a relative high percentage of type II muscle fibers in their protagonist muscles. However, this hypothesis needs further verification.

Muscular strength does not seem to affect directly the acute enhancement in performance after jumping or sprinting, which is in agreement to recent results (Terzis et. al. 2012). Moreover, hammer throwing performance was not significantly related with performance enhancement after either CMJs or 20m sprinting. This suggests that hammer throwers of various performance levels can be benefited by these interventions. In conclusion, the present results suggest that performance of either three consecutive counter movement jumps or a bout of 20m sprinting, induce an acute increase of approximately 2.4% in hammer throwing performance in experienced hammer throwers. This effect is not related with their muscular strength or their performance level. Both of these interventions can be easily executed during a hammer throw competition without the need for complex equipment.

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