Original Paper DOI: https://doi.org/10.5114/biolsport.2020.93034

Postactivation potentiation effect of two lower body resistance exercises on repeated jump performance measures

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ABSTRACT: This study examined the postactivation potentiation effects of combining squat and deadlift exercises on subsequent repeated jump performance. Fifteen, resistance-trained youth wrestlers were randomly allocated to either undertake back squats (BSq), deadlift (DL) or BSq and DL as supersets (BSq+DL), with a repeated jump protocol performed 8-minutes post-exercise in each session. Thereafter, a control condition (CON) was completed involving a general warm-up, followed by the repeated jump protocols. Power outputs, flight time, contact time and reactive strength index were recorded from each repeated jump protocol. Measures were compared between the BSq, DL and BSq+DL sessions and between sessions that generated the best power output (BEST) with CON via inferential statistics and effect size (ES) calculations. The BSq condition exhibited significantly greater power output compared to the CON condition ($p<0.05$, ES = 1.07), although no differences were identified for the other conditioning activities. Furthermore, power output, flight time and reactive strength index were significantly greater for the BEST compared to the CON condition ($p<0.05$, ES = 0.97–1.47). Results indicated that BSq was the optimal conditioning activity to increase power output during a repeated jump protocol. However, greater improvement during the BEST condition suggests that the type of conditioning activity should also be considered on an individual-basis.

CITATION: Gahreman DE, Moghadam MA, Hoseininejad E. Postactivation potentiation effect of two lower body resistance exercises on repeated jump performance measures. Biol Sport. 2020;37(2):105-112.

Received: 2019-10-25; Reviewed: 2019-11-25; Re-submitted: 2020-01-15; Accepted: 2020-01-16; Published: 2020-02-11.

Key words:
Squat
Deadlift
Power
Reactive strength index

INTRODUCTION

Greco-Roman wrestling is an individual sport that involves repetitive, explosive manoeuvres, with lower body anaerobic power being transferred up the kinetic chain as a strong determinant for performance success [1]. An effective warm-up activity that acutely enhances lower body anaerobic power is post-activation potentiation (PAP), which typically involves muscular contractions performed at near-maximal intensities. Several mechanisms have been postulated to contribute to PAP, including phosphorylation of myosin regulatory light chains, increased recruitment of higher order motor units, and changes in pennation angles of the involved muscles [2, 3]. The magnitude by which the conditioning activity affects muscular performance is determined by the net balance of potentiation and fatigue that coexists after a conditioning activity [4], which is based on individual recovery time [5].

The majority of studies to date have utilised heavy back squats (>80% of 1RM) to examine PAP effects, with vertical jump as a common outcome measure [6-8]. This popular trend of selecting back squats as a conditioning activity is surprising, given that there are a variety of lower body exercises, and that the type of conditionoing activity has been suggested to influence the magntidue of PAP effects [9]. For example, deadlift is another widely used exercise to strengthen lower body musculature, with the level of muscle activity greater for the knee flexors and lesser for knee extensors compared to back squat exercises performed at the same relative workload [10]. These distinct neuromuscular characteristics may therefore exhibit varying PAP effects, although interestingly, deadlift exercises have received limited attention for PAP research. More recently, Scott, Ditroilo [11] reported that back squat and deadlift exercises improved countermovement jump performance in resistance-trained athletes, although greater improvement was observed following deadlift exercises. Whilst these findings demonstrate potential use of deadlift exercises as a conditioning activity for PAP, Scott, Ditroilo [11] incorporated a single-effort vertical jump protocol, which may limit ecological validity given that athletes are commonly required to perform repeated jumping tasks during training and sports [12].

In addition to the mode of resistance exercise, there is a growing body of evidence indicating that the volume of conditioning activity affects the magnitude of PAP, with multiple sets of conditioning activities provoking a larger potentiation than a single set [7, 8, 13]. However, multiple sets of high-intensity activity may also induce greater fatigue that hinders performance, particularly in the early phase of recovery [8, 14], with inadequate recovery possibly explaining the lack of performance improvement as reported by previous studies. Whilst increasing the duration between conditioning activity and subsequent performance ensures recovery, this practice may also limit the potentiation effect, which has been shown to decline with increasing rest periods [6].

Combining different resistance exercise modes that engage similar muscle groups (e.g., squat and deadlift), rather than increasing the number of working sets for a given resistance exercise (e.g., squat or deadlift alone), may exhibit distinct neuromuscular stimulation for potentiation due to variant motor patterns [15], and lessen fatigue. In line with this conjecture, Kopp and De Beliso [16] investigated the effect of PAP by combining squat and deadlift as a superset (i.e., performing deadlift followed by a squat as a single set), and reported improvement in vertical jump performance. However, Kopp and De Beliso [16] did not compare the effects of superset squat and deadlift with squat and deadlift alone. Therefore, it is unclear whether the combination of exercise modes (i.e., squat and deadlift) provide distinct benefits for PAP than singular exercise modes (i.e., squat or deadlift). Determining differences in performance enhancement between conditioning activities with the combination of exercise modes to that of singular exercise modes will assist coaches in selecting the most effective priming protocols. In addition, Kopp and De Beliso [16] included participants from various athletic backgrounds, which introduces heterogeneity. Incorporating a group of anaerobically-trained athletes from equivalent sporting backgrounds, such as Greco-Roman wrestling, would enhance homogeneity of the sample. Thus, this study compared the effect of squat, deadlift, and combined squat and deadlift activities on subsequent repeated jump performance in Greco-Roman wrestlers. It was hypothesised that each condition would acutely improve repeated jump performance measures, although combining BSq and DL would exhibit the greatest PAP effect on performances.

MATERIALS AND METHODS

Research Design

This study was conducted as a cross-over, randomised design across six weeks (Figure 1). Participants completed two familiarisation sessions during the first week to practice the repeated jump protocol and to conduct a one repetition maximum (1RM) test for back squat (BSq) and deadlift (DL) exercises. During weeks 2-4, the order of the PAP conditions (i.e., BSq, DL or a combination of BSq and DL [BSq+DL]) was randomly assigned, whereby all participants completed each PAP condition in their assigned order, with each condition separated by one week. Eight minutes following each of the conditioning activities, the repeated jump protocols were carried out. This recovery period was selected based on previous studies reporting durations of 7-12 minutes to evoke PAP [17-19]. During the fifth week, participants completed two trials of the repeated vertical jump protocols without a PAP condition. The first trial was recorded as a control condition (CON) to be compared to the PAP conditions (i.e., BSq, DL and BSq+DL), whilst the second trial was used to determine the intra-day test-retest reliability of the vertical jump protocols. Each

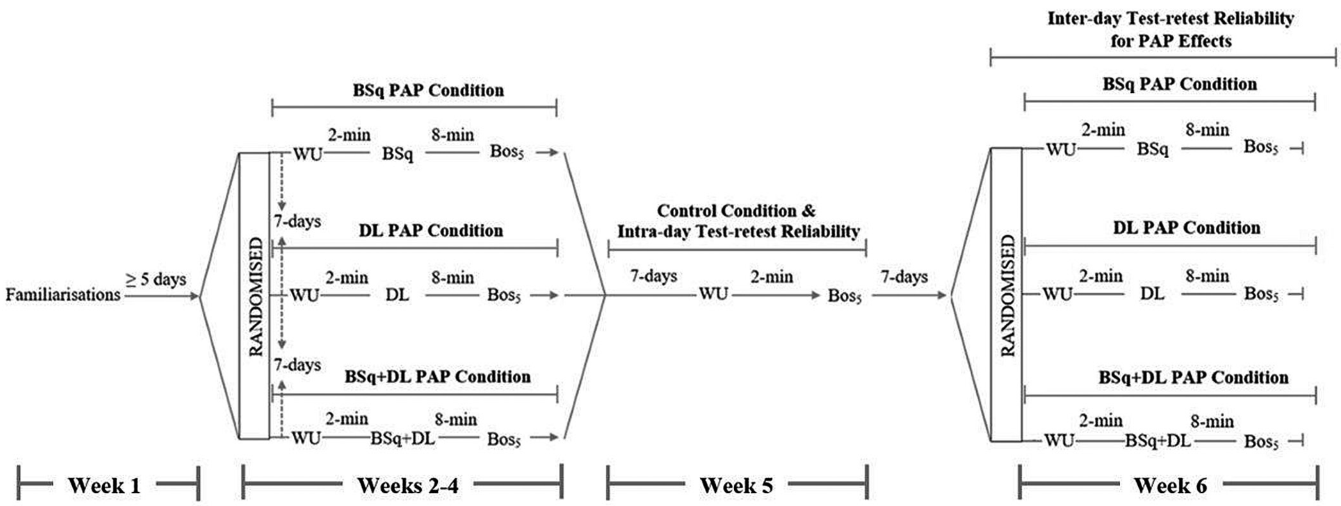

FIG. 1. Schematic of research design across the 6-week period with the warm-up (WU), back squat (BSq), deadlift (DL), the combined (BSq+DL) conditions and the 5-second Bosco repetitive jump test (Bos_5)

trial was separated by at least 10 minutes to ensure participants were recovered prior to the second trial. In the final week, participants were randomnly allocated into three groups to repeat one of the three PAP conditions (i.e., BSq, DL or BSq+DL). This procedure was undertaken to determine the inter-day test-retest reliability of PAP-induced task constraints (i.e., whether participants reproduced similar responses as a result of PAP effects). Biological variation was controlled for via the following procedures: each session was conducted between 9-11am and at the same time of the week; each protocol was conducted by the same investigators in a sport laboratory; the temperature and relative humidity of the testing facility was maintained for each testing session (25°C and 40%, respectively); the participants were requested to refrain from high intensity exercise for at least 24 hours prior to each testing session and avoid caffeine and food intake for at least 2 hours prior to testing.

Participants

Fifteen youth sub-elite wrestlers (age 15.8±1.0 years; height 1.7±0.8 m; body mass 64.7±16.6 kg; BSq 1RM relative to body mass 1.9 ± 0.3; DL 1RM relative to body mass 1.5 ± 0.2) volunteered for the study. Participants were involved in three wrestling and three resistance training sessions per week in a local wrestling club and had at least three years experience in performing the BSq and DL exercises. Whilst the participants predominantly practiced wrestling maneuvers as part of their sport, they were also familiar with jumping tasks as part of their plyometrics sessions. This research project was approved by the relevant Human Research Ethics Committee (# IR.LUMS.REC.2018.032) and was conducted in accordance with the Declaration of Helsinki. Prior to study commencement, the researchers informed participants about the risks and benefits of the study and a written informed consent was obtained from each participant. According to previous studies [6, 20], an a priori sample size calculation indicated that 15 participants were sufficient to provide greater than 80% of power and alpha of 0.05..

Familiarisation Sessions

The first session involved anthropometric measurements and familiarising the participants with the repeated jump tests by completing 2-3 trials and 2-3 sets of 10 repetitions of BSq and DL exercises at 40-50% of their reported 1RM. The depth of the BSq was set whereby the thigh came parallel to the ground, and weight belts were allowed to ensure safety. The participants were allowed to select their own grip position (e.g., width, conventional, alternated) for the DL exercise, given that the participants were accustomed to the DL manover from the daily training practices and to minimise learning effects. During the second session, the participants completed another 2-3 trials of the repeated jump tests for further familiarisation, followed by 1RM testing of the BSq and DL exercises 10 minutes thereafter.

One Repetition Maximum

The 1RM assessment was conducted using a similar procedure described previously [21]. Specifically, participants completed warm-ups sets of 8-10 repetitions of each exercise at sub-maximal loads for BSq and DL exercises. Following the warm-ups sets, participants undertook 8-10 repetitions at near maximal workloads (i.e., close to 8-10RM loads) based on perceived effort during the prior warm-up set, and in consultation with the strength and conditioning coach. After 5-minutes of rest, loads were increased by 20-30% to attempt the 1RM test, respectively, with final load achieved within 5 attempts and each attempt separated by 5-minutes. Loads were increased by 5-15% if participants perceived the load to be excessively heavy. Whilst participants were familiar with BSq and DL, for the safety of participants during 1-RM assessment and accuracy of data, correct technique were demonstrated and explained to participants by a qualified strength and conditioning coach.

Conditioning Activities

Prior to the conditioning activities, the participants undertook a progressive warm-up by jogging at a self-selected pace for 5-minutes, followed by one set of 12 repetitions, 8 repetitions and 6 repetitions at 50%, 60% and 70% of 1RM, respectively. After 2 minutes of rest, the participants completed the conditioning activities as per their allocated conditions. For the BSq and DL conditions, participants completed four sets of three repetitions at 90 percent of 1RM with 2.5 minutes of rest in-between each set. For the BSq+DL condition, the participants completed two sets of BSq and DL each, alternating between each exercise as a superset (i.e., a total of four sets), with 2.5 minutes of rest in-between each superset, although no rest was provided in-between the BSq and DL exercise.

Repeated Jump Protocol

Prior to the repeated jump tests during the CON condition, the participants completed a warm-up, with 2-minutes of jogging at a self-selected comfortable pace, followed by 4 × 9-metre sprints at 90% of maximal effort, interspersed by 60 seconds of rest. Two minutes following warm-up, measures for repeated jump performance were assessed using the 5-second Bosco repetitive jump test [22]. Measures of flight time (FT), contact time (CT), and power were generated from an electronic matt with sensitivity of 0.1 watt and accuracy of 0.01 seconds (Ergo Jump, Danesh salar Iranian, Tehran, Iran). These measures were reported as the average of the jumps performed during the 5-second period. The reactive strength index (RSI) was also calculated using the formula: $RSI = \frac{FT}{CT}$ [23]. During the repetitive jump test, the participants were instructed to position their hands on their hips, to jump as high as possible and to minimise the contact time between their feet and the electronic matt for each jump. The participants were notified to be prepared 15 seconds before the start of each attempt and were provided with verbal encouragement to sustain maximum effort throughout each protocol.

Statistical Analysis

The central tendency and dispersion were reported as means ± standard deviation, and all data were analysed using the Statistical Package of Social Sciences (SPSS 25.0 Inc, Chicago, IL). A one-way repeated measures analysis of variance (ANOVA) was used to compare differences in the repeated jump tests following different conditioning activities. In addition, given that the PAP response could differ based on the type of conditioning activity [7, 24] (e.g., some individuals may experience the PAP effect with the BSq condition, whilst others may experience the PAP effect with the DL or BSq + DL condition), a paired T-test was also used to compare measures between the CON condition and the PAP condition (i.e., BSq, DL or BSq + DL) that generated the greatest power output measure (BEST condition). To determine the magnitude of differences between each time point, effect sizes (ES) were calculated using Cohen's d with associated 95% confidence intervals (CI). The ES values of 0.2, 0.5 and 0.8 were considered as small, moderate and large, respectively [25]. A 2-way, mixed-effects ICC was used to evaluate intra-day test-retest reliability (i.e., reliability between the two measures in Week 5) and inter-day test-retest reliability (i.e., reliability between the PAP conditions from Weeks 2-4 and the PAP condition in Week 6). The ICC estimate of 0.75, between 0.74 and 0.51 and less than 0.5 were interpreted as good, moderate and poor, respectively [26]. Measurement errors between these reliability time points were also determined by calculating coefficient of variation (CV) with associated 95% CI, with values less than 10% considered acceptable [27]. In addition, a paired T-test was conducted to assess systematic bias between time points measured for reliability. The alpha level was set at $p \leq 0.05$.

RESULTS

The reliability of the performance measures are displayed in Table 1. Both inter-day (ICC =0.64-0.84) and intra-day (ICC = 0.58-0.89) test-retest reliabilities for measures of the repeated jump protocol were moderate to good. In addition, most performance measures exhibited small intra-day (CV = 2.4%-7.9%) and inter-day (CV = 3.0%-7.7%) measurement errors, except for the RSI indicating an inter-day measurement error above the acceptable cut-off of 10% (CV = 10.7%).

When comparing performance measures between conditions (Figure 2), there was a significant main time effect for power output from the Bosco jumps ($F(3, 42) = 7.2$, $p = 0.002$). Post hoc analyses demonstrated that the BSq condition exhibited significantly greater power output than the CON condition ($p < 0.05$) with a large ES calculation (1.07; Table 2). Whilst there were no differences in power output between the other conditions ($p > 0.05$), the BSq+DL condition generated greater power output than the CON condition with a moderate ES calculation (0.61). In addition, power output was greater in the BSq condition compared to the DL and BSq+DL conditions with moderate ES calculations (0.52 and 0.61, respectively).

For comparisons between the CON and BEST conditions (Figure 3), the BEST condition generated significantly greater power output, FT and RSI ($p < 0.01$), whilst significantly lower for CT ($p < 0.01$), with large ES calculations (1.47 [0.63-2.23], 0.97 [0.19-1.70]), 1.02 [0.23-1.75] and 0.81 [0.05-1.53], respectively).

DISCUSSION

The purpose of the current study was to compare the PAP effects of BSq, DL and combined BSq and DL conditions on repeated jump performance measures in resistance-trained individuals. We hypothesised that each condition would acutely improve repeated jump performance measures, although the combined BSq and DL condition would exhibit the greatest PAP effect. Interestingly, the current findings rejected our primary hypothesis, with the BSq condition as

TABLE 1. The intra-class correlation coefficient (ICC) and coefficient of variation (CV) with 95% confidence interval (CI) for power output, sprint and jump performance measures

	Trial 1	Trial 2	ICC (95% CI)	CV (95% CI)	P-value
Intra-day					
Power (W)	35.4 ± 4.7	29.7 ± 4.7	0.58 (-0.24–0.86)	6.5% (3.8%–9.0%)	0.001*
FT (Sec)	3.5 ± 0.2	3.5 ± 0.2	0.82 (0.45–0.94)	2.4% (1.6%–3.1%)	0.59
CT (Sec)	1.5 ± 0.2	1.5 ± 0.2	0.82 (0.45–0.94)	5.6% (3.9%–7.3%)	0.59
RSI	2.4 ± 0.4	2.4 ± 0.4	0.81 (0.42–0.93)	7.9% (5.5%–10.4%)	0.58
Inter-day					
Power (W)	42.1 ± 7.0	40.4 ± 8.6	0.84 (0.52–0.95)	7.5% (4.7%–10.3%)	0.31
FT (Sec)	3.7 ± 0.2	3.6 ± 0.2	0.64 (-0.07–0.88)	3.0% (1.7%–4.3%)	0.11
CT (Sec)	1.3 ± 0.2	1.4 ± 0.2	0.64 (-0.07–0.88)	7.7% (4.6%–10.8%)	0.11
RSI	2.8 ± 0.5	2.6 ± 0.4	0.66 (-0.02–0.89)	10.7% (6.3%–15.0%)	0.11

FT – flight time; CT – contact time; RSI – reactive strength index

* Significantly different between trials ($p < 0.01$)

TABLE 2. Effect size calculations with 95% confidence interval for power, sprint and jump performance measures for the control (CON), squat (Sq), deadlift (DL) and combined squat and deadlift conditions (Sq+DL)

	Power (W)	Flight Time (Sec)	Contact Time (Sec)	RSI
CON-Sq	1.07 (0.28–1.80)	0.34 (-0.39–1.05)	0.34 (-1.05–0.39)	0.46 (-0.28–1.17)
CON-DL	0.49 (-0.29–1.20)	0.28 (-044–0.99)	0.24 (-0.95–0.49)	0.37 (-0.37–1.08)
CON-Sq+DL	0.62 (0.12–1.34)	0.22 (-0.50–0.93)	0.22 (-0.93–0.50)	0.28 (-0.44–0.99)
Sq-DL	0.52 (-0.22–1.23)	0.04 (-0.76–0.67)	0.09 (-0.63–0.80)	0.07 (-0.78–0.65)
Sq-Sq+DL	0.61 (-0.14–1.22)	0.15 (-0.86–0.58)	0.15 (-0.58–0.86)	0.24 (-0.95–0.49)
DL-Sq+DL	0.01 (-0.70–0.73)	0.09 (-0.81–0.62)	0.05 (-0.67–0.76)	0.15 (-0.86–0.57)

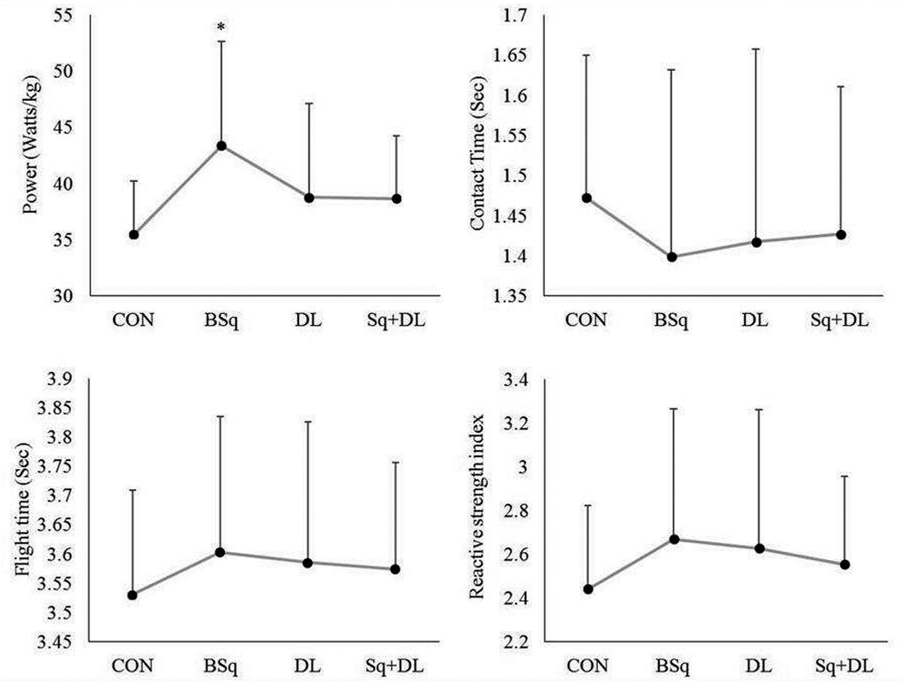

FIG. 2. The measures of power, flight time, contact time and reactive strength index collected from the repeated jump protocol during the control (CON), back squat (BSq), deadlift (DL) and combined (BSq+DL) conditions
* Significantly greater than CON ($p < 0.01$)

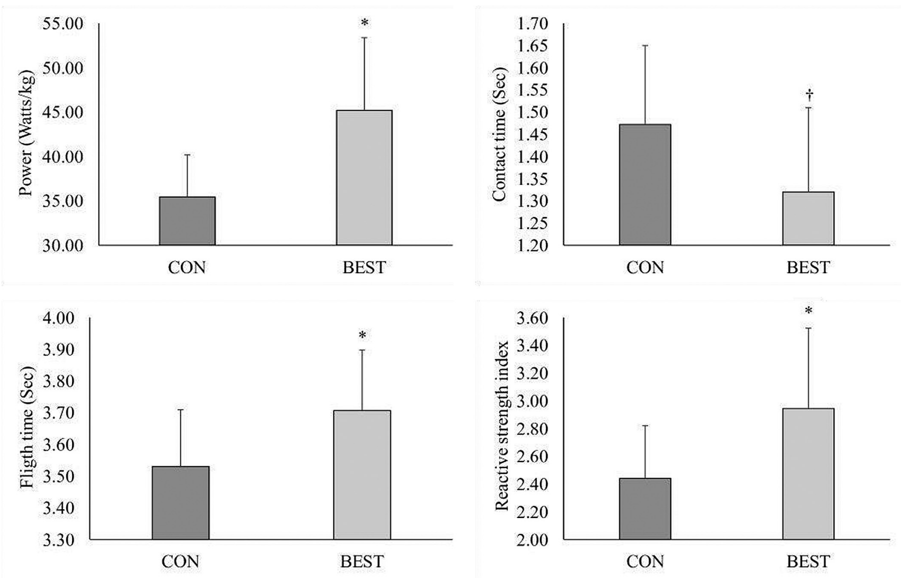

FIG. 3. The measures of power, flight time, contact time and reactive strength index collected from the repeated jump protocol during the postactivation potentiation session that generated the greatest power (BEST) and control (CON) condition
* Significantly greater than CON ($p < 0.01$)
† Significantly less than CON ($p < 0.01$)

the only condition demonstrating an improvement in repeated jump performance measures at a statistically significant level. With respect to the magnitude of differences based on ES calculations, both the BSq and BSq + DL conditions demonstrated improvement in repeated jump performance measures, although greater improvement was observed for the BSq condition than the BSq + DL condition. No changes were identified in performance measures following the DL condition, which rejects our secondary hypothesis. Accordingly, heavy BSq exercises (i.e., 90% 1RM) may be an effective priming strategy to improve repeated jump performance for training or matches, although combining BSq and DL exercises, or solely performing conventional DL, are not optimal methods for inducing PAP.

The current study identified that the BSq condition generated a large improvement in power output during repeated jump performance. As far as we are aware, Weber, Brown [20] is the only group who examined the acute effects of heavy back squats employing similar performance methods. In their study, resistance-trained men completed seven consecutive vertical jumps as a performance measure following one set of five repetitions of BSq at 85% of 1RM, which was then compared to a condition involving squat jumps with body weight. Their results showed that BSq improved jump height, with no changes in these measures following the squat jump condition. However, it is important to note that Weber, Brown [20] only incorporated one set of BSq exercises, and the repeated jump protocol was conducted immediately following the conditioning activities, which is different from our study, with four sets of heavy BSq, followed by an 8-minute recovery period. Nonetheless, our findings agree with the current consensus that 7-12 minutes is the optimal recovery period following heavy BS (≥ 85% of 1RM) to improve jump performance in well-trained individuals [17, 18]. However, for stronger athletes with greater recovery capacity, recovery periods of less than 7 minutes may be optimal with the current BSq protocol. Thus, practitioners are recommended to determine individualised recovery periods for each athlete when implementing PAP protocols. Despite some variation in methodological approach used, the current findings, and those of previous studies [28-30], collectively demonstrate that heavy BSq is an effective mode of resistance exercise to improve vertical jump performance characteristics.

When compared between conditions, the current study identified that the magnitude of improvement was greater following the BSq condition than the BSq + DL and DL conditions. Directly comparing these findings to previous studies is at present difficult, given that no other studies have examined acute effects of PAP following combined BSq and DL exercises as a superset in relation to singular resistance exercise modes (i.e., BSq and DL alone). However, when BSq and DL were performed in isolation, our results contrasted those of Scott, Ditroilo [11], who reported greater improvement in peak power output during a countermovement jump protocol following DL compared to BS performed at 93% of 1RM. These discrepancies in findings may be due to the distinct DL technique, given that Scott, Ditroilo [11] utilised a hex bar performed as a concentric-only contraction, by dropping the bar at the end of the concentric phase to avoid resistance during the eccentric phase. The authors postulated that this lifting technique might have reduced neuromuscular fatigue, and thus enabling a greater effect of PAP. Indeed, Scott, Ditroilo [11] reported improvement in peak power as early as 2-minutes post-conditioning activity, demonstrating that the participants required minimal recovery to experience PAP, as opposed to common recovery periods of 7-12 minutes [17-19]. In addition, Scott, Ditroilo [11] suggested that the hex bar might have provided better load distribution across the joints in the lower extremity, thereby improving transferability between the conditioning activity and subsequent performance. This conjecture would support the lack of changes in repeated jump performance measures following the conventional DL condition in the current study, given that a straight bar was employed. In fact, Till and Cooke [31] also reported that five repetitions of conventional DL at 5RM exhibited no changes in vertical jump performance for up to 9 minutes post-exercise, further confirming the lack of PAP effects with a conventional DL manoeuvre. Therefore, the potential to elicit greater PAP effects by combining different resistance exercise modes may have been minimised by the DL technique employed in the current study. Further research could determine the compatibility of BSq with DL using concentric-focused contractions, or using a hex bar to optimise PAP effects. In addition, it is possible that the combination of BSq and DL may have induced greater physiological stress than the BSq only condition. Thus, 8 minutes of recovery may have been insufficient to optimise the PAP effect, with further research warranted to explore various recovery periods following PAP protocols that combine multiple resistance exercise exercises as a super-set.

Although the BSq improved power output, there were no differences in the other measures derived by the repeated jump protocol (i.e., FT, CT and RSI) with small ES calculations. However, comparison between the BEST and CON conditions indicated significant improvement in the majority of the repeated jump measures (i.e., power output, FT and RSI) with large ES calculations. These findings suggest that the optimal conditioning activity may have been somewhat individualised, with some participants potentially experiencing greater effects of PAP following the BSq + DL or DL conditions than the BSq condition. Indeed, others have observed a similar phenomenon with distinct temporal changes in PAP effects between individuals [32], with suggestions that the magnitude of PAP effect may be influenced by muscular strength, training background and recovery dynamics of individuals [7, 8]. The participants in the current study were a relatively homogenous group of wrestlers. However, slight variations in muscular strength, preference for the type of conditioning activity and resistance training experience between participants may have contributed to this variation in ideal resistance exercise mode (i.e., BSq or DL) for optimising PAP.

The current study has a number of limitations that warrant further discussion. Firstly, it cannot be ruled out that the warm-up protocol incorporated in the CON condition prior to the repeated jump protocol exhibited voluntary PAP stimuli which was not present during the BSq, BSq + DL and DL conditions. Nonetheless, the repeated jump performance measures during the BSq and BSq + DL conditions exceeded the CON condition, indicating that the heavy resistance exercises generated larger PAP effects than the warm-up protocol for the CON condition. Similarly, there is a possibility that the first few repetitions during the repeated jump protocol provided further PAP effects for subsequent jumps. However, the performance protocol was identical for each condition, thus any potential voluntary stimuli induced during the repeated jump protocol would have been equivalent for each testing session. Furthermore, we acknowledge that the inter-individual variation in muscular strength and physical characteristics may have influenced the present findings, as confirmed by greater differences between the BEST and CON conditions. Nonetheless, we made every effort to homogenise the sample by selecting participants from a wrestling team who undertook standardised training programs, with experience in resistance training. Finally, whilst repeated jumping capabilities may not have direct relevance to Greco-Roman wrestling, the ability to maintain lower body anaerobic power is essential in this sport. Thus, the PAP protocols implemented in the current study may benefit Greco-Roman wrestlers, and potentially provide even further enhancement for athletes in sports that involve repeated jumping manoeuvres (e.g., volleyball, basketball, ski jumper), although further research is needed to confirm this conjecture.

CONCLUSIONS

In summary, heavy BSq provided the greatest PAP effect for repeated jump performance, with some level of improvement following the combination of BSq and DL, and no effects following the DL exercise with 8-minutes of recovery. However, when the BEST condition was compared with the CON condition, even larger improvement in repeated jump performance was identified. Thus, several sets of heavy BSq exercises could be considered as part of a pre-conditioning activity to improve repeated jump performance for complex training (e.g., performing heavy back squats prior to plyometrics) or matches for resistance-trained individuals. However, the degree to which BSq, DL and the combination of the two resistance exercise modes maximises PAP may be dependent on the individual. Thus, BSq appears to be the best conditioning activity to optimise lower body anaerobic power for most athletes, although coaches are recommended to trial various resistance exercise modes, as optimal conditioning activities may differ for some athletes.

Acknowledgment

The authors have no acknowledgements to declare.

Conflict of interest

The authors have no conflict of interest to declare.

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