The Effect Of Post Activation Potentiation Of Back Squat On 50 Meter Sprint Performance Among 100m Male Sprinters

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Abstract. Post Activation Potentiation (PAP) refers to performance improvement through neuromuscular stimulation in a short period of time as a result of undergoing specialized training activities. PAP is also referred to as a physiological condition in which an increase in muscle power over the previous one such as the movement of plyometric activity. Although research has shown lifting heavy back squat to be an effective method of increasing PAP effects, little data exist on its effect on distance above 40 meter sprinting. This study aims to investigate the effect of post activation potentiation of back squat on 50 meter sprint performance among 100 meter male sprinters. Specifically, it investigates whether the effect of post activation potentiation of back squat has an impact on 50 meter sprint performance. There are 20 of 100 meter male sprinters performed 50 meter sprints and rest 1 minute after the 1 repetition of the back squat at 90% of 1 Repetition Maximum [RM]). Maximal sprint times at 50 meter were measured using timing gates. Data were analyzed using paired sample t-test. However, with large individual variations in the response to the back squat with 90% of 1RM, data shown some sprinters benefit from the effects of PAP and others not. Thus, the results showed no significance difference in investigate the effect of post activation potentiation of back squat on 50 meter sprint performance among 100 meter male sprinters.

Keywords: Back Squat, Sprint Performance.

1 Introduction

Post activation potentiation (PAP) is a well recognized phenomenon that involves the preconditioning of muscle through heavy exercise to induce acute improvements in human performance during sprinting, running, throwing, and weightlifting activities (1). The mechanism for PAP has been primarily attributed to the phosphorylation of myosin regulatory light chains, which make the protein filaments acting and myosin more sensitive to the release of calcium (Ca2+), and this triggers a cascade of events to enhance the muscle response (2). The recruitment and subsequent expression of the high order motor units offer a secondary mechanism to explain PAP response of muscles (3).

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Back squat are a popular exercise and it might be the one that necessary equipment s that will equip in the training centre (4).Usually back squats have been frequently utilised in study for induce a response in PAP for elite, beginners or unskilled people. Although numerous research on PAP have found increases in terms of functional results following various squat workouts and procedures (5), a comparable number have found no effect in results (6). On the other hand, an important factor is the transfer of the PAP stimulus to specific sports muscle actions. In this context, most studies investigate the influence of PAP on lower limbs and evaluate the performance improvement through vertical jumps (7). Therefore, despite the evidence supporting the acute potentiating effects of heavy resistance exercises on improving subsequent explosive performance, there is smaller number of studies investigating the effects of heavy resistance exercises on subsequent sprint running performance. This study will close the gap in the literature by investigate the effect of post activation potentiation of back squat on 50 meter sprint performance among 100m male sprinter. The result will provide suggestions to the coaches and athletes to implement the PAP method in the training and competitions.

2 Experimental Approach to Problem

To investigate the effects of back squats on sprinting performance, a randomised, crossover, and counterbalanced design was utilised. Back squats were chosen because they are simple to do and have been shown to improve performance (8). The chosen test (50m sprint) was designed to give a performance outputs that were relevant to the research group (100m male sprinters), such as speed and power, and allow direct comparisons between lower-body workouts and speed.

2.1 Subjects

This research included 20 trained 100m male sprinters who were all current active athletes for the collection of data. The participants must have experience in pull-push training (resistance) for about a year and sprint training experience, and the inactive period cannot be more than three weeks. Subjects must have at least one year of back squat experience and be able to attain or surpass 90% of their 1RM intensity. Subjects who have an illness or injury that prevents them from doing well in any of the study's activities are barred from taking part.

2.2 Study Protocols

The individual took part in the first training session and finished the test process to achieve 1RM in the back squat. Following the completion of the first session, the participants took part in a second session to assess sprinting result that under free weight circumstances and next under post activation potentiation settings. The 20 subjects will be testing the PAP protocol (90% of 1RM back squat) in the first week. The 20 subjects will be testing the non-PAP protocol using free weights (back squats) in the following week to avoid muscle fatigue. The subject will perform a dynamic warm-up before lifting. Before attempting 1RM, subjects performed 10 reps of 35%, 5 reps of 75%, and 1 rep of 90% of back squat. Between each attempt, the subject rested for 6 minutes. The test is performed on a squat rack using free weights and an observer. For a successful attempt, at the end of eccentric exercise, their feet must be level on the platform and their thighs must be parallel to the platform. Before the 50-meter sprint test, the subjects rested for 1 minute after performing 1RM squats and weight control. Subjects are required to wear

running gear during every test phase with the control and experimental phases at the same time of the day. The test takes place on the outdoor track from late in the morning to early in the afternoon. The course starts with a dynamic warm-up, including jogging and 30 minutes of dynamic exercises. After warming up, instruct the subjects to start post-control or PAP squat exercises. The subjects rested for 1 minute between the back squat and the first of the three repetitive sprints to be performed in each group. Before the next PAP training, the individuals executed three reps of 50-meter sprints with a rest time of 9 minutes. This is the end of the first 10 minutes of the test. Two more groups were conducted. At the end of the rest period after the 9-minute sprint, the subject squatted again and started the next set.

2.3 Statistical Analyses

The subjects got to perform three sprint test during the non-PAP session and three sprint tests during the PAP session. Furthermore, every subjects best sprint time, in seconds (sec), from each session was analyzed, with the help of Microsoft Excel 2020. The Shapiro-Wilks test was used to check for normality and the Paired Sample T-Test will determine significant differences in sprint performance with and without PAP. Both the Shapiro-Wilks test and the Paired Sample T-Test were executed in IBM SPSS v.21. The level of significance was set at $p < 0.05$.

3 Results

There were the same 20 subjects listed in the testing. The effect of PAP of back squat (90% of 1RM) result elicited decreased of 0.03150 (95% CI, -0.42 to 0.11) compared to with back squat (no weights) on 50 meter sprint performance result showed in Figure 3. The effect of PAP of back squat (90% of 1RM) a statistically significant decrease in the 50 meter sprint performance compared to with back squat (no weights), $t(19) = 0.896$, $p<0.001$.

With a median value of 6.405 seconds, a minimum value of 6.01 seconds and a maximum value of 6.68 seconds for the sprint result with back squat (no weights). Besides, a median value of 6.34 seconds, a minimum value of 5.91 seconds and a maximum value of 6.65 seconds for the sprint result with back squat (90% of 1RM). It is including the maximal effort in the back squat, consisting of one repetition of half squat with the weight of ninety percent of 1 rep max, did not result in post activation potentiation and did not increase the sprint performance amongst the male sprinters in the study. There was no statistically significant difference between means ($p>.05$), and therefore, we can reject the hypothesis.

4 Discussion

Table 1 Paired Samples Test

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	With Back Squat (90% of 1RM) - With Back Squat (No Weights)	.03150	.15719	.03515	-.04207	.10507	.896	19	.381

The aim of the present study was to investigate the effect of post activation potentiation of back squat on 50 meter sprint performance among 100m male sprinters. Our findings show that lifting back squat with 90% of 1RM that induced PAP did not have any significant differences compared to doing back squat without weights. We found out that it may cause by the volumes, rest intervals and intensities in the study. Heavy weights have been shown to improve vertical jump and sprint performance, in both intervention and acute studies (9). In contrast, previous studies have reported no difference in acute sprint performance after heavy-resistance exercise . Indeed, in the current study, over the course of three trials, there was no significant difference in sprint performance. These results agree with the findings of McBride, who reported no effect of heavy-resistance exercise on repeated sprint performance using similar rest intervals. Although, it was suggested that PAP can only effectively contribute to performance enhancements within 1–5 minutes after conditioning contractions. As PAP and fatigue are simultaneously initiated after muscle contractions, we posit that the effect of PAP was sufficient to counteract the effect of fatigue in doing the back squat with 90% of 1RM but inadequate for enhancing the sprinting performance. Besides that, the inconsistencies in the research regarding the optimal intensity for inducing PAP make it difficult to provide recommendations for training prescription. Despite the fact that the bulk of studies indicates that heavy-load intensities tend to be the most beneficial . For example, doing a 3RM back squat at around 90% of 1RM may elicit a higher PAP response than performing a 10RM back squat at 50% of 1RM. As a result, it is recommended that employing large loads (>80% of 1RM) may be the most effective for producing substantial potentiation. In this study, we did 1 repetition of back squat at around 90% of 1RM and did not shows significant differences in improving the 50 meter sprint performance. Therefore, we believed that we may need to do 3 to 5 repetitions with the same intensities (90% of 1RM) or lower the repetitions with higher intensity such as 95% of 1RM. The volumes, rest intervals and intensities that used in our study have previously been shown to be sufficient for improving the sprint performance (10). However, it shows no significant differences in the sprint results, therefore, it would be interesting to indicating that the complex relationship between the volumes, rest interval and intensities warrants further investigation.

4.1 Conclusion

The result shows no significant differences in sprint performance in doing heavy back squat, as a result, we need to reject the hypothesis. This study may need to further investigate in the volumes, rest intervals and the intensities. Post activation potentiation has been consistently

proven to improve subsequent athletic performance such as sprint, however, it may be necessary to take into account the type, intensity, and volume of the conditioning exercise since this has been shown to contribute to both the amount of the fatigue and the magnitude of the potentiation. PAP benefits are generally maximised when biomechanically comparable workouts are done with high loads for minimum repetitions. PAP's effects are extremely personalised, according to the research, implying that there will never be a "one size fits all" approach for training prescription.

4.2 Suggestion for Future Research

Future research is recommended to conduct the research has several aspects must be considered when adopting back squat protocols for competition, including an individual's athletics ability, equipment availability, time restrictions, modality, and coach/athlete buy in.

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