

# ECCENTRIC PHASE DURATION HAS NO IMPACT ON THE MAGNITUDE OF POST-ACTIVATION PERFORMANCE ENHANCEMENT

Krzysztofik M.<sup>1</sup>, Pisz A.<sup>1</sup>, Kolinger D.<sup>1</sup>, Jarosz J.<sup>2</sup>, Wilk M.<sup>2</sup>, Stastny P.<sup>1</sup>

<sup>1</sup> Department of Sport Games, Faculty of Physical Education and Sport, Charles University, Prague, Czech Republic

<sup>2</sup> Institute of Sport Sciences, The Jerzy Kukuczka Academy of Physical Education, Katowice, Poland



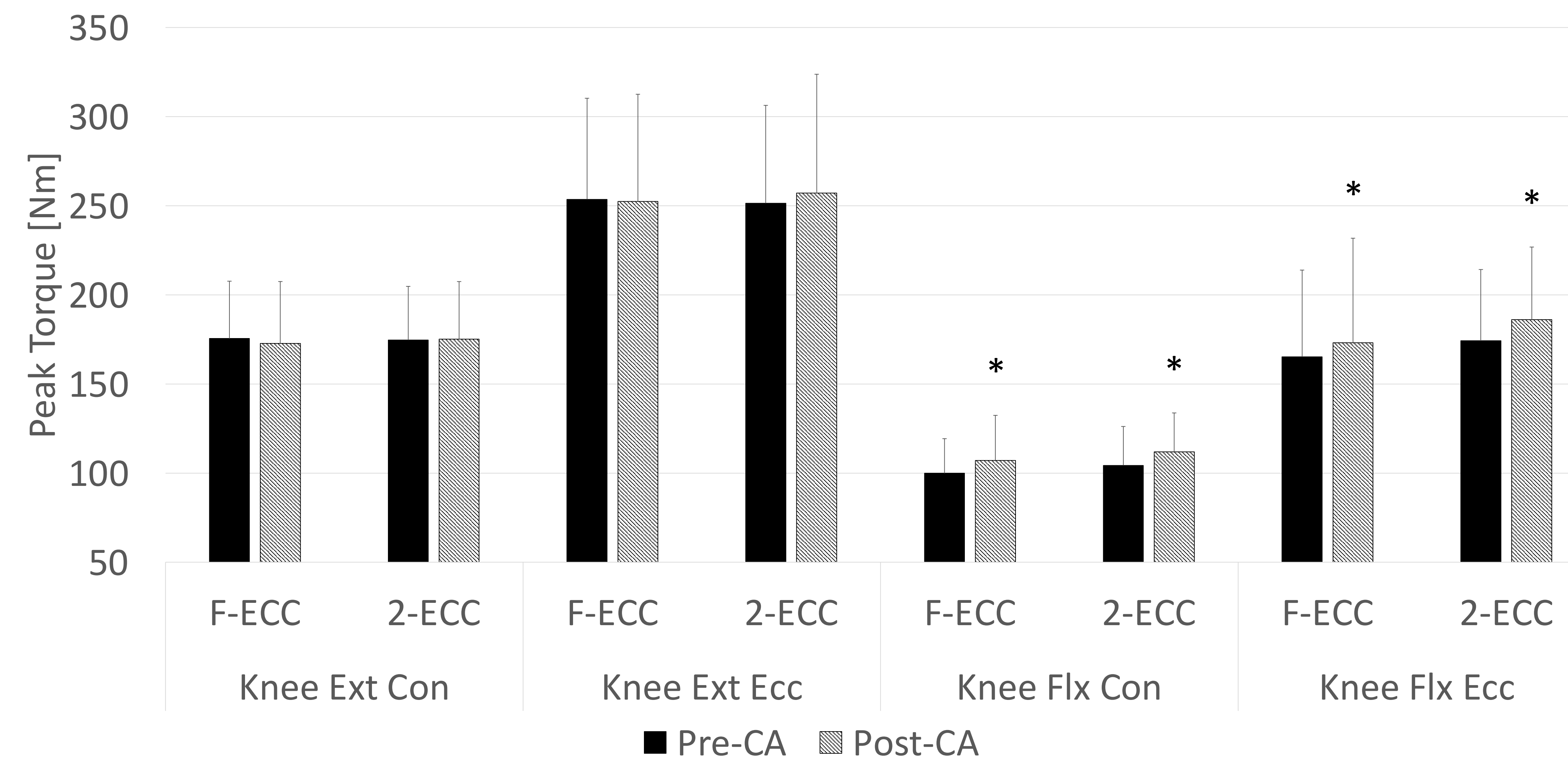
## PURPOSE

The post-activation performance enhancement (PAPE) phenomenon refers to a brief, intense voluntary activity that will increase the performance of a subsequent athletic task. This effect could be used in training and as part of a warm-up. The PAPE is largely examined in terms of appropriate conditioning activity (CA) setups. The specific properties of eccentric contractions raise interest in their utilization as conditioning exercises. However, studies to date have been mainly focused on comparing the effects of different intensities, while little attention has been paid to the impact of various eccentric phase durations. Therefore, this study examined whether high-intensity front squats employing rapid (as fast as possible) eccentric phases would induce higher improvements in peak torque during isokinetic knee flexion and extension compared to front squats performed with a 2s fixed eccentric phase duration considered to be close to a volitional one.

## METHODS

Fifteen male handball players (age  $16.3 \pm 1.2$  years; body mass  $79.9 \pm 9.9$  kg; body height  $184 \pm 6.4$  cm; personal body fat  $10.3 \pm 5.2$  %; 3RM  $74.3 \pm 19.1$  kg) with previous resistance-training experience performed two experimental sessions in a randomized order in which 3 repetitions of front squats at 90% one-repetition maximum (1RM) performed with either rapid or fixed to 2s eccentric phases were applied as a CA. The maximum dominant limb isokinetic knee flexion and extension were performed in concentric and eccentric muscle action modes to further examine the effects of PAPE, which may manifest differently across muscle action types.

Measurements were performed before and at 5th, 7th, and 9th min after the CA with an angular velocity of  $180^\circ \cdot s^{-1}$  on an isokinetic dynamometer (Humac Norm, Stoughton, MA, USA) in the form of 3 flexions and 3 extensions with a rest interval of 15 seconds. Due to the high inter-individual variability in the PAPE responses and the individualized recovery time approach, the highest value obtained post-CA was retained for further analysis.



**Figure 1.** Preconditioning and postconditioning activity peak torque results. Results are presented as mean and standard deviation. F-ECC – fast eccentric; 2-ECC – 2s eccentric; Ext – extension; Flx – flexion; Con – concentric; Ecc – eccentric; CA – conditioning activity; \* significant difference in comparison to pre-CA within condition.

## RESULTS

The two-way ANOVA showed no statistically significant interactions ( $p=0.729$  and  $p=0.413$ ) or main effects of time ( $p=0.754$  and  $p=0.700$ ) and condition ( $p=0.892$  and  $p=0.910$ ) for peak torque during the knee extension in both concentric and eccentric muscle action. Moreover, no statistically

significant interactions ( $p=0.931$  and  $p=0.451$ ) nor the main effects of the condition ( $p=0.108$  and  $p=0.205$ ) for knee flexion, concentric and eccentric, were found. However, statistically significant main effects of time ( $p=0.002$  and  $p=0.001$ ) to increase peak torque from baseline to post-CA for knee flexion, concentric and eccentric, were found.

## CONCLUSION

The current study found that the front squat at 90% 1RM with either a fast or a 2s eccentric phase duration elicited a comparable magnitude of PAPE response. Surprisingly, there was a significant PAPE response during isokinetic knee flexion for both concentric and eccentric muscle action, but not during knee extensions for either muscle action. These results suggest that front squats induce the PAPE effect in knee flexor muscles instead of knee extensors.

## PRACTICAL APPLICATIONS

Coaches and practitioners could use high-load, low-volume front squats as the CA during complex training sessions to elicit the lower limb PAPE effect. Furthermore, they can choose between rapid and volitional eccentric phase durations based on their own preferences without regard for the magnitude of the PAPE effect. At the same time, it appears that when using PAPE in practice, practitioners should choose front squats to improve following athletic tasks that engage knee flexor muscles.

## ACKNOWLEDGEMENTS

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