

## 1 *Effect of volume on eccentric overload-induced post-activation potentiation of jumps*

### 2 3 **Abstract**

4  
5 **Purpose:** To investigate the post-activation potentiation (PAP) effects of different eccentric  
6 overload (EOL) exercise volumes on countermovement jump (CMJ) and standing long jump  
7 (LJ) performance.

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9 **Methods:** Thirteen male university soccer players participated in a cross over design study  
10 following a familiarization period. Control (no PAP) CMJ and LJ performances were recorded,  
11 and three experimental protocols were performed in a randomized order: 1, 2 or 3 sets of 6  
12 repetitions of flywheel EOL half-squats (inertia=0.029 kg·m<sup>2</sup>). Performance of CMJ and LJ  
13 were measured at 3 and 6 min following all experimental conditions. The time course and  
14 magnitude of the PAP were compared between conditions.

15 **Results:** Meaningful positive PAP effects were reported for CMJ after 2 (Bayes factor  
16 [BF<sub>10</sub>]=3.15, *moderate*) and 3 (BF<sub>10</sub>=3.25, *moderate*) sets but not 1 set (BF<sub>10</sub>=2.10, *anecdotal*).  
17 Meaningful positive PAP effects were reported for LJ after 2 (BF<sub>10</sub>=3.05, *moderate*) and 3  
18 (BF<sub>10</sub>=3.44, *moderate*) sets but not 1 set (BF<sub>10</sub>=0.53, *anecdotal*). Two and three set protocols  
19 resulted in meaningful positive PAP effects on both CMJ and LJ after 6 but not 3 min.

20  
21 **Conclusion:** This study reported beneficial effects of multiple-set eccentric overload exercise  
22 over a single set. A minimum of two sets of flywheel EOL half-squats are required to induce  
23 PAP effects on CMJ and LJ performance of male university soccer players. Rest intervals of  
24 around 6 min (greater than 3 min) are required to maximize the PAP effects via multiple sets  
25 of EOL exercise. However, further research is needed to clarify the optimal EOL protocol  
26 configurations for PAP response.

27  
28 **Keywords:** strength, training, flywheel, squat, Bayesian statistics

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## 1 Introduction

2 Acute enhancement of force and power production underpins successful execution of sporting  
3 tasks by athletes of varying levels.<sup>1-3</sup> Such enhancement of voluntary muscle contractions has  
4 previously been termed post-activation potentiation (PAP).<sup>4</sup> Several physiological mechanisms  
5 leading to temporary neuromuscular and biochemical adaptations in the musculoskeletal  
6 system are proposed to contribute to the PAP phenomenon.<sup>4,5</sup> The most accredited theory  
7 relates to an upsurge of  $\text{Ca}^{2+}$  sensitivity in the sarcoplasmic reticulum, increasing  
8 phosphorylation of myosin regulatory light chains, and enhancing twitch force and rate of force  
9 development.<sup>4</sup> Based upon this rationale, PAP protocols are implemented to enhance athletic  
10 performance prior to competition or during training.

11

12 Various methods have been used to induce PAP in athletes and untrained populations.<sup>1-3</sup> These  
13 protocols implemented either maximal isometric actions or dynamic heavy resistance exercise  
14 loads (*e.g.* > 85% 1RM) to induce an acute effect on performance.<sup>6,7</sup> However, a recent body  
15 of research has suggested using alternative conditioning activities that are biomechanically  
16 similar to the subsequent exercise in terms of the kinematic and kinetic variables associated  
17 with the movements, and the muscle actions involved.<sup>8,9</sup> Among other methodologies,  
18 eccentric overload (EOL) exercise has consistently proven to be effective for acutely improving  
19 horizontal and vertical jumping performance.<sup>5,10,11</sup> Such exercise utilizes the physiological  
20 advantages offered by a greater loading of the eccentric phase of the exercise (*e.g.* squat).<sup>12</sup>  
21 This overload facilitates greater motor unit recruitment and triggering of sarcoplasmic calcium  
22 release,<sup>13</sup> considered the main central and peripheral mechanisms underpinning PAP.<sup>10</sup>  
23 Eccentric exercise has also been shown to selectively recruit type II muscle fibres,<sup>12</sup> which are  
24 more sensitive to the PAP phenomenon.<sup>13,7</sup> From a methodological perspective, EOL only  
25 requires a short familiarization process even for athletes without extensive experience of  
26 traditional weightlifting.<sup>14</sup> Such a short amount of time is a negligible cost in view of the  
27 possible performance benefits. Moreover, flywheel devices have the advantage of being easily  
28 transportable compared to traditional weightlifting devices, supporting their utilization in an  
29 applied context.

30

31 While EOL has been extensively studied as a training strategy,<sup>1,12,13,15,16</sup> the topic remains  
32 relatively unexplored as an approach to stimulate PAP effects. In particular, the modalities  
33 necessary to optimally elicit a PAP response, via manipulation of intensity (inertia) and volume  
34 (number of sets), affecting the fatigue-potential relationship and the consequent time-course  
35 of the PAP effects, are still unknown.<sup>4,9</sup> Conditioning exercise volume may have an important  
36 impact on both the onset and magnitude of PAP effects, which are crucial for practitioners  
37 attempting to optimize jump,<sup>1,13</sup> sprint,<sup>5,9,15</sup> and change of direction performance.<sup>16,17</sup> The  
38 effects of different volumes on PAP effects have been marginal and only investigated with  
39 regard to traditional PAP protocols.<sup>7,8</sup> High volumes of traditional resistance exercise methods  
40 may cause excessive fatigue, either requiring a longer time window for PAP or possibly  
41 nullifying it.<sup>6,7</sup> Nonetheless, greater peak power responses have been observed following multi-  
42 set protocols (*e.g.* 2 and 3 sets) in comparison to a single-set protocol, even if no differences  
43 were observed in jump height.<sup>2</sup> Eccentric overload protocols present the potential advantage of  
44 maximizing the neuromuscular response via optimized use of the eccentric phase,<sup>12</sup> possibly  
45 reducing the volume necessary to elicit a PAP stimulus within complex training methodologies.  
46 Specifically, the management of EOL volume may play a key role in altering PAP time  
47 windows and magnitudes,<sup>2,4</sup> with fatigue being reduced at a quicker rate than muscular PAP  
48 and potentiation becoming dominant in the second part of the recovery period (generally after

49 3 min).<sup>1</sup> Considering the lack of evidence regarding the impact of flywheel EOL volume on  
50 PAP,<sup>9</sup> this investigation may help practitioners optimize volume prescription for PAP or  
51 complex training methodologies aimed at acutely enhancing athletic performance.<sup>14,17</sup>

52  
53 The aim of this study was to compare the effects of different volumes (1 set vs 2 sets vs 3 sets)  
54 of flywheel EOL squats used as a PAP protocol on countermovement jump (CMJ) and standing  
55 long jump (LJ) performance of soccer players. We hypothesized that multiple sets (2-3 sets)  
56 may generate a more delayed but greater PAP response than a single set protocol (1 set).

57

## 58 **Methods**

59

### 60 **Participants**

61 Thirteen university male soccer players were recruited for this study (mean  $\pm$  SD; age  $20 \pm 1$   
62 years, body mass  $72.1 \pm 7.8$  kg, height  $1.79 \pm 0.06$  m). Inclusion criteria were the absence of  
63 any injury or illness (Physical Activity Readiness Questionnaire), and regular participation in  
64 soccer training (minimum two sessions per week) and competition (once per week). All  
65 participants were informed of the potential risks and benefits of the procedures and signed an  
66 informed consent form. The Ethics Committee of the University of Suffolk (UK), approved  
67 this study. All procedures were conducted according to the Declaration of Helsinki for studies  
68 involving human participants.

69

### 70 **Experimental Design**

71 A randomized, crossover study design was used to investigate the acute effects of different  
72 volumes (1 set vs 2 sets vs 3 sets) of EOL exercise on jumping performances. Participants did  
73 three familiarization sessions to become acquainted with the EOL exercise procedures.<sup>14,16</sup>  
74 They attended the laboratory on 4 further sessions.<sup>14</sup> During the first session, baseline CMJ and  
75 LJ performances were assessed and used as control measures (no PAP stimulus) to compare  
76 the effects of the three experimental protocols. During each of the remaining occasions,  
77 participants completed a standardized warm up, one of the three PAP protocols in a randomized  
78 order, and CMJ and LJ reassessment after 3, and 6 min of passive recovery (see Figure 1 for  
79 the study layout). Similar experimental procedures have been used in previous studies  
80 exploring acute responses to EOL exercise.<sup>1,2,16</sup>

81

82

*Figure 1, here please*

83

### 84 **Procedures**

85 Body mass and height were recorded by stadiometer with inbuilt scales (Seca 286dp; Seca;  
86 Hamburg, Germany). A standardized warm-up included 10 min of cycling at a constant power  
87 ( $1 \text{ W} \cdot \text{kg}^{-1}$  body mass) on an ergometer (Sport Excalibur lode, Groningen, Netherlands).  
88 Dynamic mobilization exercises for a duration of 3 minutes, using the same procedure  
89 previously described by this research group,<sup>1,16</sup> consisted in of dynamic movements mimicking  
90 the EOL exercise (e.g., half squat) and dynamic hip, knee, and ankle movements. Participants  
91 were asked to maintain habitual exercise habits and to refrain from consuming depressive (e.g.  
92 alcohol) or ergogenic (e.g. coffee) substances 24 hours prior to the experimental sessions.<sup>15</sup> All  
93 sessions were performed between 10:00 AM and 14:00 PM, at least 48 hours after the last  
94 competition or training session to avoid the effects of accumulated fatigue on performance.<sup>2,18</sup>

95

#### 96 *Countermovement jump (CMJ)*

97 Countermovement jump height was assessed using Optojump technology (Optojump Next,  
98 Microgate, Bolzano, Italy).<sup>17</sup> Maximal CMJs were performed with a self-selected depth and

99 with hands on hips to prevent the influence of arm swing.<sup>3</sup> Validity and reliability of this test  
100 were previously reported.<sup>19</sup> An *excellent* test-retest reliability was observed in the present  
101 study: intraday ICC=0.93, and inter-day ICC=0.90; which are in agreement with previous  
102 evidence.<sup>1</sup>

### 103 104 *Standing long jump (LJ)*

105 A LJ test was used to measure the horizontal jumping ability.<sup>20</sup> Participants performed one  
106 maximal bilateral anterior jump with arm swing. Jump distance was measured from the starting  
107 line to the point at which the heel contacted the ground on landing.<sup>21</sup> The validity and reliability  
108 of this test was previously reported in the literature.<sup>22</sup> A *good* test-retest reliability was observed  
109 in the present study: intraday ICC=0.90, and interday ICC=0.91; which are in agreement with  
110 previous evidence.<sup>16</sup>

### 111 112 *PAP protocols*

113 The PAP protocols consisted of EOL half squat exercises using a flywheel ergometer (D11  
114 Full, Desmotec, Biella, Italy). The protocols were configured as either 1, 2, or 3 sets of 6  
115 repetitions<sup>1</sup>, interspersed by 2 min of passive recovery. Each movement was qualitatively  
116 evaluated by an investigator, offering kinematic feedback to the athletes as well as strong  
117 standardized encouragements to maximally perform each repetition. The load used for the  
118 protocols consisted of a combination of one large disc (diameter = 0.285 m; mass = 1.9 kg;  
119 inertia = 0.02 kg·m<sup>2</sup>) and one medium disc (diameter = 0.240 m; mass = 1.1 kg; inertia = 0.008  
120 kg·m<sup>2</sup>). The inertia of the ergometer (D11 Full) was estimated as 0.0011 kg·m<sup>2</sup>. The total inertia  
121 utilized in this study was 0.029 kg·m<sup>2</sup>.<sup>1</sup> The participants were instructed to perform the  
122 concentric phase at maximal velocity and to achieve approximately 90° of knee flexion during  
123 the eccentric phase. The EOL inertia and procedure reported in this study was previously  
124 utilized with flywheel ergometers to produce a PAP effect and its full description has been  
125 recently reported.<sup>1</sup>

### 126 127 **Statistical analysis**

128 All statistical analyses were conducted using JASP (Amsterdam, Netherlands) software version  
129 0.9.2. Data were presented as mean ± SD. The test-retest reliability was assessed using an  
130 intraclass correlation coefficient (ICC) and interpreted as follows: *excellent* ≥ 0.9; 0.9 > *good*  
131 ≥ 0.8; 0.8 > *acceptable* ≥ 0.7; 0.7 > *questionable* ≥ 0.6; 0.6 > *poor* ≥ 0.5; *unacceptable* < 0.5.<sup>23</sup>  
132 A fully Bayesian statistical approach was utilized to provide probabilistic statements.<sup>24</sup> The  
133 sample size power was calculated (based on a previous study using the same experimental  
134 protocol)<sup>1</sup> by G-power and corrected for a Bayesian infarction factor, n=13.<sup>25</sup> Each analysis  
135 was conducted with a “noninformative” prior (Cauchy distribution, 0.707).<sup>25</sup> A Bayesian-  
136 repeated measures ANOVA was used to evaluate the effects of time (within; control, 3 min,  
137 and 6 min) and conditions (between; 1 set vs. 2 sets vs. 3 sets) on CMJ and LJ performance. If  
138 a meaningful Bayes factor (BF<sub>10</sub>) was identified, a post-hoc was performed.<sup>26</sup> Evidence for the  
139 alternative hypothesis (H<sub>1</sub>) was set as BF<sub>10</sub> > 3 and evidence for null hypothesis was set as BF<sub>10</sub>  
140 < 1/3. BF<sub>10</sub> was reported to indicate the strength of the evidence for each analysis (within and  
141 between), and interpreted using the following evidence categories: 1 < *anecdotal* evidence for  
142 H<sub>1</sub> < 3; *moderate* ≥ 3; *strong* ≥ 10; *very strong* ≥ 30; *extreme* ≥ 100.<sup>27</sup> Markov Chain Monte  
143 Carlo with Gibbs sampling was used to make inferences (10000 samples). Estimates of median  
144 standardized effect size ( $\delta$ ) and 95% credible interval (CI) were calculated.<sup>28</sup>  $\delta$  was interpreted  
145 by Cohen as *trivial* < 0.2; *small* ≥ 0.2; *moderate* ≥ 0.6; *large* ≥ 1.2; *very large* > 2.0.<sup>29</sup>

### 146 147 148 **Results**

149  
150 Meaningful positive PAP (time; Table 1) effects were reported for CMJ after 2 ( $BF_{10} = 3.15$ ,  
151 *moderate*) and 3 ( $BF_{10} = 3.25$ , *moderate*) sets but not 1 set ( $BF_{10} = 2.10$ , *anecdotal*). Meaningful  
152 positive PAP (time; Table 1) effects were reported for LJ after 2 ( $BF_{10} = 3.05$ , *moderate*) and  
153 3 ( $BF_{10} = 3.44$ , *moderate*) sets but not 1 set ( $BF_{10} = 0.53$ , *anecdotal*). Two and three set  
154 protocols resulted in meaningful positive PAP effects (post-hoc; Table 2) on both CMJ and LJ  
155 after 6 ( $3.05 \leq BF_{10} \leq 7.64$ ) but not 3 min ( $0.60 \leq BF_{10} \leq 1.31$ ). Post-hoc analysis was not  
156 performed for 1 set since no meaningful time effect was observed. A non-meaningful time x  
157 condition interaction was observed for CMJ ( $BF_{10} = 0.03$ ; evidence for  $H_0$ ) and LJ ( $BF_{10} =$   
158  $0.06$ , evidence for  $H_0$ ). No overall meaningful differences between conditions (sets) were  
159 observed in CMJ ( $BF_{10}=0.08$ , evidence for  $H_0$ ) or LJ ( $BF_{10}=0.09$ , evidence for  $H_0$ ). Post-hoc  
160 analysis between conditions were not performed since no meaningful interaction effect was  
161 observed.

162  
163  
164 *Table 1 and Table 2 here, please.*  
165

## 166 Discussion

167 The current study is the first to investigate the effects of PAP protocols using flywheel EOL  
168 squats with different volumes on CMJ and LJ performance. Three findings emerged: firstly,  
169 time (PAP) effects on CMJ and LJ were observed only following the multi-set protocols and  
170 not the single-set protocol; secondly, these PAP effects were evident only after 6 min and not  
171 after 3 min of recovery; finally, no differences between conditions (number of sets) were  
172 reported on the onset or magnitude of CMJ and LJ performance enhancement.

173  
174 The findings of the current study are in line with the recent evidence reporting improved  
175 horizontal and vertical jump performances following PAP protocols implementing EOL  
176 exercises.<sup>1,16</sup> These potentiating effects may arise from mechanical advantages and  
177 neuromuscular mechanisms associated with the execution of EOL exercises as potentiating  
178 activities prior to an athletic task. Eccentric overload is achieved due to the increased inertial  
179 load of the flywheel mechanism, which demands higher mechanical force and power  
180 production during the exercise.<sup>1,16</sup> In addition, eccentric contractions commonly induce both  
181 neural and muscular adaptations which are defined as the common central and peripheral  
182 mechanisms underpinning the PAP phenomenon.<sup>6,30</sup> Peripheral adaptations allowing for  
183 increased muscle responses may be associated with the passive factors that underpin the cross-  
184 bridge mechanisms, possibly relating to the binding of calcium to certain areas of titin, thereby  
185 enhancing stiffness and force upon lengthening during eccentric actions.<sup>30</sup> Furthermore, EOL  
186 may preferentially activate high-threshold (type II) fibers.<sup>12,13,30</sup>

187  
188 The second main finding of this study highlighted that greater than 3 min of rest (*e.g.* 6 min)  
189 were necessary to elicit a PAP response. A large amount of literature supports the findings that  
190 a rest period is necessary for eliciting a PAP response.<sup>4,6</sup> Specifically, it appears that 3-7 min  
191 of rest are required for performance enhancement of jumping ability with traditional methods,<sup>8</sup>  
192 although another meta-analysis reported that 5-7 minutes were necessary.<sup>7</sup> Whilst no PAP effect  
193 was present at 3 min in the current study, the time-course of the PAP effects reported are  
194 partially consistent with previous EOL PAP investigations, which reported enhanced CMJ and  
195 LJ performance after 3 and 6 min of rest.<sup>1,16</sup> Previously, a study reported differences in squat  
196 peak force and impulse after 5 minutes of passive recovery, which supports the present  
197 findings.<sup>1</sup> Although some uncertainty remains regarding optimal rest periods,<sup>7,8</sup> these findings  
198 highlight the importance of a recovery period between the completion of the PAP stimulus and

199 the beginning of subsequent exercise. Furthermore, the lack of a meaningful difference in time  
200 window between conditions is in itself a new result.

201  
202 The present study hypothesized that differences between 1 set and multiple sets of EOL squats  
203 on PAP response would have occurred as a consequence of the balance between transient  
204 fatigue and potentiation, both present at the completion of the conditioning activity.<sup>1,2,7</sup> A  
205 higher exercise volume may have increased the neuromuscular response, but may also have  
206 generated greater transient fatigue. Conversely, a lower EOL volume may have minimized the  
207 magnitude and duration of fatigue but may have failed to enhance muscular activation and  
208 subsequent athletic performance.<sup>6,7,30</sup> The current study reported that both 2 and 3 sets  
209 enhanced performance, whereas 1 set of EOL squats did not. Therefore, the findings of the  
210 current study support the use of multi-set EOL exercise to stimulate PAP,<sup>7</sup> in agreement with  
211 previous recommendations using traditional resistance methods.<sup>8</sup>

212  
213 In previous studies, volume has been considered as a key modulator for PAP.<sup>4,9</sup> A recent  
214 investigation by Bauer et al.<sup>2</sup> comparing different volumes of traditional back squats reported  
215 enhanced jumping performance consistently throughout all sets, but significant peak power  
216 increases after 2 and 3 sets in comparison to 1 set. No previous studies have utilized a flywheel  
217 device to investigate the impact of EOL volume on PAP response. It has been supposed that  
218 the use of a small volume (1 set) of flywheel exercise could generate PAP effects based on the  
219 characteristics of the EOL exercise, which increases the mechanical demands during the  
220 eccentric portion of a squat and could, therefore, generate a PAP response within the previously  
221 reported time windows.<sup>30</sup> Considering the present findings, which did not observe a meaningful  
222 PAP response using such a volume, it is possible that the effectiveness of the EOL protocol  
223 may have been determined by the participants' ability to maximally recruit muscle in the  
224 eccentric portion of the movement. This may significantly impact both fatigue accumulated  
225 and muscle activation.<sup>30</sup> Therefore, it could be possible that athletes with extensive experience  
226 in EOL training could report different results compared to the inexperienced participants used  
227 in the current research. Alternatively, other factors (*e.g.* coordination) have been previously  
228 reported to impact jump performance, which could explain the current findings.<sup>1-3</sup> Future  
229 studies could use other measures, which involve a lower movement coordination, such as  
230 concentric knee flexion and extension peak torque via isokinetic testing. These measures,  
231 which are correlated with sport specific tasks such as jumping and sprinting ability, may offer  
232 further clarification on this topic.<sup>1</sup>

233  
234 This study suffers from a number of limitations worthy of discussion. Firstly, although all the  
235 soccer players participated in familiarization sessions before the study initiated,<sup>14</sup> possible  
236 inter-participant differences in reaction to the novel conditioning activity used in this study  
237 may have played a role in PAP responses.<sup>30</sup> Further familiarization may possibly allow for  
238 greater adaptations to the unique neural activation patterns experienced during EOL  
239 contractions. Additionally, this study evaluated baseline (control) test values in a separate  
240 session and so possible learning effects should be considered as a limitation. Further  
241 investigations should replicate the current protocol recruiting other cohorts with a training  
242 background and different fitness levels.<sup>1,2,9</sup> Further research is needed to clarify whether the  
243 combined effects of intensity and volume could generate a different PAP response.<sup>16</sup> Multiple  
244 sets of using lower intensity may induce less fatigue and be more effective for less trained  
245 cohorts than higher intensity dynamic exercise.<sup>8</sup> Alternatively, higher intensities (0.075 - 0.1  
246 kg·m<sup>2</sup>) may acutely enhance power production<sup>14</sup> and subsequent performance within elite  
247 cohorts.<sup>8,30,31</sup> Although different intensities of EOL squats have previously resulted in no  
248 meaningful difference in jump potentiation,<sup>16</sup> they may differentially activate musculature of

249 the lower limbs in individuals.<sup>18</sup> Recording the power output during EOL exercise may help to  
250 clarify this.

251

### 252 **Conclusion**

253 This study is the first to have reported the beneficial effects of multiple-set eccentric overload  
254 exercise over a single set in a lower body multi-joint movement to elicit PAP. Jumping ability  
255 was enhanced after 6 but not 3 min of recovery, which makes the balance between transient  
256 fatigue and potentiation relevant also for eccentric overload conditioning activities. Further  
257 research is necessary to confirm whether such findings can be generalized for different  
258 populations (*e.g.* elite), as well as whether PAP response differences exist using differing  
259 exercise prescriptions such as volume, intensity or a combination of both of these variables.

260

### 261 **Practical Applications**

262 The results support using 2-3 sets of eccentric overload exercise as a valid preload strategy to  
263 enhance vertical and horizontal jumping performance in male athletes during training sessions  
264 or before competitions. However, single set eccentric overload protocols should not be  
265 recommended. These performance enhancements can be maximized after 6 min of passive  
266 recovery, while 3 min of recovery may be not sufficient, due to transitory fatigue, to elicit a  
267 PAP response. Practitioners should consider the PAP time window reported in the current study  
268 following an eccentric overload protocol to enhance the sport-specific performance of their  
269 athletes.

270

271

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274

### 275 **References**

276

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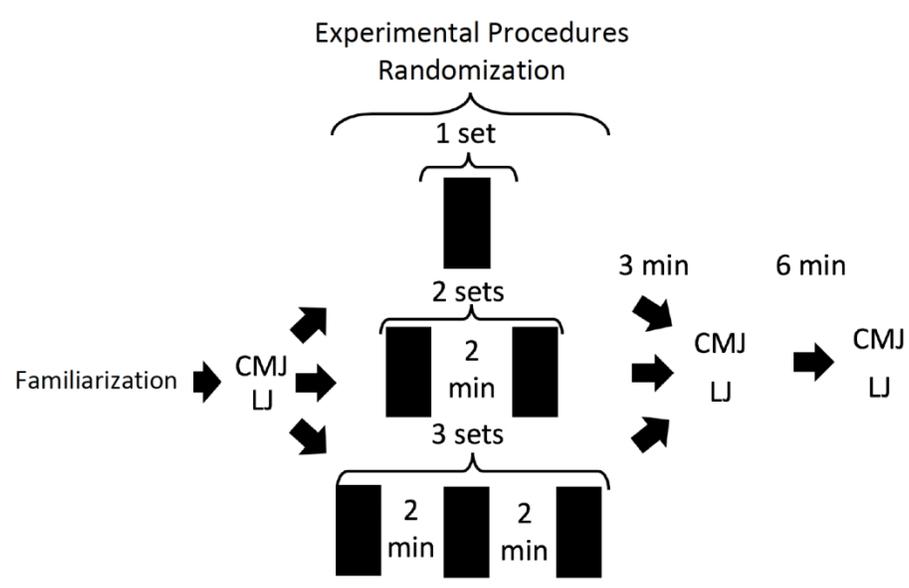
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Figure 1. Flowchart of the study design and experimental procedures



CMJ = Countermovement jump; LJ = Standing long jump

298x225mm (144 x 144 DPI)

1

1 Table 1. Post-activation potentiation effects on CMJ height and LJ distance at 3 and 6 min after 1, 2, or 3 sets of flywheel half squats via Bayesian  
2 ANOVA.

Variable	Control Mean $\pm$ SDs	PAP 3 min Mean $\pm$ SDs	PAP 6 min Mean $\pm$ SDs	ANOVA BF <sub>10</sub>	BF <sub>10</sub> Interpretation
<b>CMJ (cm)</b>					
1 set	35.7 $\pm$ 5.7	37.6 $\pm$ 4.8	37.2 $\pm$ 5.7	2.10	Anecdotal
2 sets		37.5 $\pm$ 4.6	37.4 $\pm$ 5.3	3.15	Moderate
3 sets		37.1 $\pm$ 5.5	37.7 $\pm$ 6.1	3.25	Moderate
<b>LJ (m)</b>					
1 set	2.14 $\pm$ 0.15	2.19 $\pm$ 0.14	2.18 $\pm$ 0.14	0.53	Anecdotal
2 sets		2.19 $\pm$ 0.15	2.20 $\pm$ 0.14	3.05	Moderate
3 sets		2.18 $\pm$ 0.14	2.22 $\pm$ 0.18	3.44	Moderate

3

4 PAP = Post-activation potentiation; SD = standard deviation; CMJ = countermovement jump; LJ = long jump; BF<sub>10</sub> = Bayes factor.

1 Table 2. Jump performance outcomes for the control and experimental conditions (2 and 3 sets). Post-hoc results for the conditions showing the  
 2 magnitude of improvements in CMJ and LJ performance over time for different numbers of sets

<b>Variable</b>	<b>BF<sub>10</sub></b> <b>3 min</b> <i>Interpretation</i>	<b>BF<sub>10</sub></b> <b>6 min</b> <i>Interpretation</i>	<b>δ (95% CI)</b> <b>3 min</b> <i>Interpretation</i>	<b>δ (95% CI)</b> <b>6 min</b> <i>Interpretation</i>
<b>CMJ (cm)</b>				
2 sets	1.31 <i>Anecdotal</i>	3.05 <i>Moderate</i>	0.47 (-0.07, 1.05) <i>Small</i>	0.61 (0.01, 1.24) <i>Moderate</i>
3 sets	1.10 <i>Anecdotal</i>	7.64 <i>Moderate</i>	0.44 (-0.08, 1.00) <i>Small</i>	0.77 (0.19, 1.43) <i>Moderate</i>
<b>LJ (m)</b>				
2 sets	1.19 <i>Anecdotal</i>	4.36 <i>Moderate</i>	0.45 (-0.09, 1.03) <i>Small</i>	0.68 (0.09, 1.31) <i>Moderate</i>
3 sets	0.60 <i>Anecdotal</i>	6.67 <i>Moderate</i>	0.32 (-0.19, 0.85) <i>Small</i>	0.76 (0.15, 1.42) <i>Moderate</i>

3  
 4 PAP = post-activation potentiation; CMJ = countermovement jump; LJ = long jump; BF<sub>10</sub> = Bayes factor; δ = effect size; CI = credible intervals.