Original Investigation

Effects of resistance priming exercise on within day jumping performance and its relationship with strength level

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Abstract

This study aimed to identify the effects of same day resistance priming exercise on countermovement jump parameters and subjective readiness, and to identify whether baseline strength level influenced these outcomes. Fourteen participants performed two separate conditions (Priming [2 sets high-load parallel squats with a 20% velocity loss cut-off] and Control) in a randomized, counterbalanced crossover design. Countermovement jump was assessed at pre, post and 6h while readiness was assessed at pre and at 6h only. All countermovement jump force-time metrics were similar between conditions ($p>0.05$), but different individual responses were noted 6h after priming. Jump height was increased for 4/14, decreased for another 4/14 and maintained for 6/14 participants at 6h. Higher perceived physical performance capability ($p<0.001$) and activation balance ($p=0.005$) were observed after priming only. Positive relationships were observed between strength and the percentage change in jump height (r=0.47-0.50; p=0.033-0.042), concentric peak velocity (r=0.48-0.51; p=0.030-0.041) and impulse (r=0.47; p=0.030-0.045) at post and 6h after priming exercise. These findings suggest that velocity-based high-load low-volume priming exercise has potential to positively impact jump performance and subjective readiness later that day in certain individuals. Participant absolute strength level may influence this response but should be confirmed in subsequent studies.

Keywords: Velocity loss; recovery; squat; delayed potentiation; fatigue

Introduction

While the application of long-term resistance training has been shown to improve athletic performance[1,2], an opportunity to transiently improve performance with resistance exercises also exists[3]. These conditioning activities, termed 'priming' resistance exercise(s), are usually performed on the same day[4–8] or the day before[6–11] a competition/task in attempt to produce a transient increase in performance in the next 2-48h. Some of the physiological mechanisms that have been suggested to be involved in these changes in performance have been the potential to activate high frequency motor neurons, increases in muscle temperature, increases in mechanical stiffness [12], increased fiber sensitivity to calcium ions [13] and/or changes in the daily concentration of testosterone and cortisol after exercise[6]. Currently, there is no clear consensus on the conditioning activities that maximize the priming response. Previous research has explored different set configurations and recovery times between the end of the priming exercise and the time of evaluation, with disparate responses observed[4–7,10]. For example, Harrison et al.,[10] observed that low-volume squat-based priming exercise with a moderate load (65%1RM) increased countermovement jump height (CMJ) by 6.1%, 8 hours afterwards. Similarly, high load (67-87%1RM) priming also resulted in a 4.5% increase in squat jump height at 8 hours with a positive improvement in perceived "physical feeling"[10]. Additionally, Cook et al.,[6] observed that back squat and bench press priming with higher training volume (12 sets) and performed to muscle failure increased CMJ peak power output in rugby union players. However, Dahl et al.,[5] did not observe any improvement in jump height likely due to the presence of low frequency fatigue after the resistance priming exercise. Given known detrimental effects of fatigue on performance, research has also considered controlling for fatigue during the priming exercise. Specifically, González-García et al.,[7] used a velocity-based repetition cutoff approach, however, showed inconsistent performance enhancement in CMJ height amongst participants as a result of inter-individual variability.

As priming exercise appears to exert a positive delayed effect on physical performance for some, but not all athletes[7], understanding the relationship between an athlete's characteristics and the different delayed physical performance effects seems relevant. To our knowledge, only one investigation has attempted to identify whether participants' prior characteristics influence the response to priming exercises[11]. This study showed that 5 sets of 4 repetitions in the jump squat exercise increased CMJ height and several kinetic and kinematic variables of concentric and eccentric phases of the jump 24 hours after the priming exercise has been finished, but only in stronger participants (half squat relative strength=2.22 Kg/BM). Weaker participants (half squat relative =1.76 Kg/BM) did not show any benefit after the priming session in any of the variables analyzed.

Given that there is no clear consensus on the benefit of priming exercises on within-day vertical jump performance, and that strength levels appear to influence the response to these conditioning activities, the objectives of the present investigation are as follows: i) to identify whether low-volume, high-load velocity-based priming exercise is effective in increasing vertical jump performance and subjective readiness, and ii) to determine if there is a relationship between changes in vertical jump metrics and participants' baseline strength level. Based on the findings of previous research[6,7,10,11], we hypothesize that: i) there would be different individual responses to priming exercise on jumping performance, ii) that subjective readiness would be improved, and iii) that there would be a relationship between participants' strength level and the response to same day priming exercise. From a practical standpoint, knowing which athletes are more likely to positively response to resistance priming exercises may allow these conditioning activities to be prescribed more appropriately.

Methods

A randomized and counterbalanced repeated measures design was used to identify the potential delayed performance enhancement of the priming exercise. CMJ force-time metrics and psychological readiness measures were assessed at three different times throughout the same day; prior to priming exercise or control (Pre), immediately after the priming exercise or control period (Post), and again 6 hours later (6h). Participants visited the laboratory on three separate occasions to carry out one familiarization session and two experimental days (i.e., Priming and Control). Experimental conditions were separated by 72 hours to allow complete recovery. For all conditions, participants were allowed breakfast but were asked to refrain from alcohol and caffeine for 24 hours prior to the session. They were also not allowed to engage in any strenuous physical activity between laboratory visits. Participants were allowed to leave the laboratory and eat or drink but they were required to replicate the same nutritional and fluid intake in both conditions. They were asked about their nutrient intake as well as their physical activity each time they came to the laboratory to ensure that they complied with the instructions.

Participants

An a-priori sample size estimation revealed that a minimum of six participants were required for a within-factors repeated measures ANOVA assuming a partial eta-squared (η^2) of 0.533 for CMJ[7], with a repeated measures Pearson´s correlation of 0.98 and values of 5% and 1% for type I and type II errors, respectively. However, 14 active young participants (10 males and 4 females), were recruited for this study (Mean±SD: body mass (BM): 73.2±13.4 kg; height: 1.74±0.08 m; body mass index: 24.1±3.1; age: 24.9±3.7 years; resistance training experience: 46.4±27.3 months; absolute parallel squat repetition maximum: 120.5±28.0 kg; and relative parallel squat repetition maximum: 1.6±0.2 kg/BM). Participants were informed about the experimental procedures and the possible risks and benefits prior to participation. They also gave their written informed consent to participate in this research during their first attendance at the laboratory. The study and informed consent procedures were approved by Camilo José Cela

Research Ethics Committee in accordance with the latest version of the Declaration of Helsinki. Subjects were informed of the benefits and risks of the investigation prior to signing the institutionally approved informed consent document to participate in the study.

Insert figure 1 about here

Experimental design

Figure 1 displays the flow-chart of the investigation. During familiarization, participants signed the informed consent and performed a standardized warm-up as previously described[7]. After warming-up, participants performed three CMJs with 30 seconds rest between attempts. Participants returned to the laboratory after 2 hours to perform another three CMJ to calculate intra-day reliability. After the second CMJ data collection, the evaluation of the participants' parallel squat one-repetition maximum (1RM) was carried out following the methods of Seitz et al[14]. Technique and squat depth (i.e., top of the thighs parallel to the ground at the end of the eccentric phase) were visually assessed by the principal investigator. Additionally, a linear encoder with a sampling frequency of 1000Hz and a resolution of 1mm (Chronojump, Barcelona, Spain) was used to identify the range of movement during the squat. Two randomized conditions were implemented throughout the investigation: 1) Control: where participants sat quietly for the same duration (~15 minutes) as the priming exercise session, and 2) Priming: where participants carried out a low-volume high-load resistance exercise in the morning (08:00-10:00AM). The priming exercise consists of two sets with the 80%1RM in the parallel squat, with a velocity loss of ~20% regarding the fastest repetition in each set[7,15]. This velocity loss was selected to limit metabolic and neuromuscular fatigue[16] due to reductions in the level of effort of each set[17]. Participants were encouraged to perform each repetition as fast as possible without taking their feet off the ground. To avoid any effect of circadian rhythms on the jumping performance, participants were scheduled at the same time in both experimental conditions[18]. The descriptive characteristics of the priming exercise are shown in Table 1.

Insert Table 1 about here

To identify the immediate and delayed effects produced by the priming exercise on jump metrics, each participant performed three CMJs at pre, post and 6h. Each CMJ was performed on a Force-Decks FD4000 Dual Force platform (ForceDecks, London, United Kingdom), with a sampling rate of 1,000 Hz. Center-of-mass (COM) velocity was calculated by dividing vertical force (minus body weight) by body mass and then integrating the product using the trapezoid rule. Instantaneous power was determined by multiplying the vertical force by the COM velocity. COM displacement was determined by double integrating the vertical force data[19]. The CMJ was considered successful if it was performed with the arms akimbo and if participants stayed completely still for at least one second during the weighing phase[20]. The onset of the movement was determined when a drop of 20 N from baseline force (recorded during weighing phase) was produced. Intraclass correlation coefficients and smallest worthwhile change of all force-time metrics are shown in Table 2:

- Jump outcomes: jump height (derived from vertical velocity at take-off), reactive strength index modified (RSImod=jump height/contraction time), concentric and eccentric peak velocity and absolute and relative to body mass (BM) concentric and eccentric mean power.
- Jump kinetics: concentric mean force/BM, concentric impulse, concentric impulse at 100ms and eccentric mean force.
- Jump strategy: concentric duration, eccentric duration, contraction time and countermovement depth.

Subjective readiness was assessed using an adaptation of the short recovery stress scale (SRSS)[21] at pre and 6h. In the SRSS the domain is scored directly using a 7-point Likert scale (0-6) where '0' means '*does not apply at all*' and '6' means '*fully applies*'. Participants were asked to state how they currently felt at each time point. This psychometric test has been recently validated, showing an adequate reliability[22]. To use the SRSS similarly to previous research with priming exercises[21], only physical performance capability, mental performance capability, activation balance and overall stress were queried. The instructions for answering these tests are analogous to those used in the original SRSS and acute recovery stress scale.

Statistical analysis

Statistical tests were carried out using IBM SPSS Statistics v26.0 (IBM Corp., Armonk, NY, U.S.A.). Data reported during familiarization were normally distributed. Intraclass correlation coefficients (ICC) with 95% confidence intervals (95%CI) were analyzed as follows: poor reliability, <0.5; moderate reliability, 0.5-0.75; good reliability, 0.75- 0.90; and excellent reliability, >0.90[23]. Participants who responded positively, negatively, or did not respond to priming exercise, were identified when the absolute change was less or greater than the smallest worthwhile change (SWC=0.2 x between-subject SD[10,24]). Two-way repeated measures ANOVAs with 95%CI were performed to identify the effects of the priming intervention and time of evaluation on outcome measures. Bonferroni's *post-hoc* test was used to check pairwise comparisons. Additionally, estimated magnitudes (Cohen's *d*) were calculated between groups and classified as follows: ≤0.2 trivial, ≥0.2-0.6 small, ≥0.6-1.2 moderate, ≥1.2-2.0 large, and ≥2 very large[25]. Pearson's correlations (r) with 95% CI and coefficient of determination (r^2) were also calculated to determine the relationships between change in jump metrics with lower limb strength. Results are expressed as mean ± standard deviation (SD). The significance level was set at $p<0.05$.

Results

Insert Figure 2 about here

CMJ performance and associated kinetics were worse at the post timepoint for Priming without any difference in jumping strategy (*p*>0.05). Specifically, lower jump height (Δ[95%CI] =-2.47cm [-3.72 to -1.22]; *p*=0.001), concentric mean power/BM (Δ[95%CI] =-1.49W/Kg [-9.97 to -0.01]; *p*=0.049), concentric peak velocity (Δ[95%CI] =-0.086m/s [-0.129 to -0.044]; *p*=0.001) (Figure 2) and concentric impulse (Δ[95%CI] =-7.19Ns [-10.70 to -3.61]; *p*=0.001) (Table 3) were observed in comparison to Control (Table 3).

At 6h, jump height (Δ[95%CI] =-0.14cm [-0.92 to 0.64]; *p*=0.700), concentric mean power/BM (Δ[95%CI] =0.47W/Kg [-0.47 to 1.41]; *p*=0.301), concentric peak velocity (Δ[95%CI] =-0.005m/s [-0.035 to 0.025]; *p*=0.726) and concentric impulse (Δ[95%CI] =-0.45Ns [-2.07 to 1.17]; *p*=0.559) were similar between Priming and Control. No differences were observed in any jumping strategy variable between or within conditions (Table 3). Individual responder analysis revealed that 4/14 increased, 4/14 decreased and 6/14 maintained similar CMJ height at 6h based on the SWC. Similarly, RSImod was increased in 5/14 participants, decreased in 6/14 and maintained in 3/14.

Insert Table 3 about here

Moderate significant positive relationships were observed at post and at 6h between parallel squat 1RM and the percent change in jump height, concentric peak velocity, and concentric impulse (Figure 3).

Insert Figure 3 about here

Interestingly, relative half-squat 1RM (1RM/BM), displayed small non-significant relationships with percent change in jump height (r=0.21; *p*=0.240), concentric peak velocity (r=0.18; *p*=0.264) and concentric impulse (r=0.19; *p*=0.254) at the post timepoint. At 6h, small non-significant relationships were observed between relative parallel squat 1RM (1RM/BM) and the percentage change in concentric peak velocity (r=0.18; *p*=0.392), concentric impulse (r=0.11;

p=0.357) and concentric mean force/BM (r=0.25; *p*=0.198). Changes in jump height at 6h in the Priming condition was also related to changes in RSImod (r=0.60; *p*=0.023), concentric mean power/BM (r=0.76; *p*=0.002), concentric peak velocity (r=0.99; *p*<0.001), concentric mean force /BM (r=0.54; *p*=0.046), concentric impulse (r=0.97; *p*<0.001) and concentric impulse at 100ms (r=0.47; *p*=0.045).

Higher physical performance capability was observed in Priming condition at 6h in comparison to pre (Δ[95%CI] =+1.32 points [0.71 to 1.93]; *p*<0.001). Between conditions comparison revealed higher but not significant physical performance capability at 6h (Δ[95%CI] =+0.64 points [-0.22 to 1.31]; *p*=0.057) (Figure 4). Activation balance was higher in the Priming condition at 6h in comparison to pre (Δ[95%CI] =+0.86 points [0.31 to 1.41]; *p*=0.005). No differences between pre and 6h were observed in Control (Δ[95%CI] =-0.71 points [-0.35 to 0.48]; *p*=0.720) (Figure 4).

Insert Figure 4 about here

Discussion

As hypothesized, different responses in jumping metrics were displayed among participants. Another main finding that supported to the hypothesis was that physical performance capability and activation balance improved 6h after priming. Moreover, absolute strength, but surprisingly not relative strength, was positively and moderately related to changes in jump height, concentric peak velocity and concentric impulse immediately (i.e. less reduction) and 6h (i.e. improvement) after priming exercise (Figure 3).

As expected, the completion of the priming exercise produced an immediate decrease in jump height (-9.45%), RSImod (-9.66%), concentric mean power/BM (-6.77%) and concentric peak velocity (-3.83%) (Table 3, Figure 2). These were also accompanied by reductions in concentric mean force/BM (-3.13%) and concentric impulse (-4.56%) without changes in jumping strategy (Table 3). To our knowledge, only a handful of studies have evaluated different vertical jump metrics after velocity-based resistance priming exercises[7,10,26]. Pareja-Blanco et al.,[26] observed an immediate reduction in jump height of ~6.0% after 3 sets of 4 repetitions with 80%RM in the back squat exercise with a similar velocity loss cut-off (22.7%±6.9%). Additionally, Harrison et al.,[10] showed that CMJ and squat jump height were reduced by 3.7% and 3.5% after priming exercise, respectively. These reductions in jumping capacity occurred without changes in force production during the concentric phase in both the moderate- and high-load conditions after a maximum of 10 repetitions spread over 4 sets[10]. On the other hand, increasing the level of effort does not seem to be an effective strategy either[26]. For example, when training is performed to muscular failure, there are greater reductions in jump height immediately after exercise (-32.5%) and can remain reduced 24 hours later (-8.5%)[26]. These larger reductions in vertical jump may explained by the peripheral fatigue produced after a strenuous physical activity which may lead to reductions motor unit firing rates[27] and/or sodium potassium pump efficiency[28] in addition to increases in lactate and ammonia values[29]. In this sense, these biological markers suggest that metabolic and peripheral fatigue may limit the usefulness of priming exercise if performed to muscle failure, as full recovery may not be achieved by competition time[26].

At 6h, the priming condition presented similar values in comparison to control in all the CMJ variables analyzed suggesting an adequate CMJ recovery (Table 3). Our results agree with previous research that has used velocity-based priming exercise where jump height was fully recovered[10] or also increased at 6h[7]. However, looking more closely at the individual level we observed that only four of the 14 participants in this study increased CMJ height at 6h, while four showed a decrease. Participants who improved their CMJ height also had the greatest absolute parallel squat 1RM values (>140kg) (Figure 3) but surprisingly, this effect did not extend to relative strength (r=0.21; p=0.240). These results may be explained because participants with higher lower-limb strength, despite higher body mass, have shown earlier and greater potentiation enhancement after strength/power complexes[14]. Considering the influence of maximal dynamic strength values on the priming effect, Nishioka and Okada[11] observed that participants with relative half squat (90º knee flexion) strength greater than 2.22 kg/BM (1RM= ~162Kg) increased eccentric rate of force development, eccentric mean velocity, eccentric mean power, concentric mean force, concentric mean velocity and concentric mean power which translated into greater jump height. However, these increases were not observed in weaker participants (1RM/BM=1.76Kg/BM, absolute 1RM=122Kg). In the current study, relative parallel squat strength of participants was 1.65±0.21 Kg/BM (range=1.27-1.99 Kg/BM), which is less than that of the 'weaker group' reported by Nishioka and Okada[11]. Hence, this may be a possible reason why we did not observe a relative strength effect in current study at 6 hours. However, half squat presents a lower velocity associated to 1RM which allow to increase the total external load (and modify velocity- and power-load relationships) lifted in comparison to parallel squat[30].

Further analysis revealed that changes in CMJ performance outcomes and kinetics at the different time points assessments were correlated with participants' absolute 1RM in the barbell parallel back squat exercise. As observed in figure 3 (Panel A), there is a tendency for stronger participants to maintain higher impulse and peak velocity in the concentric phase, which translates into smaller reductions in jump height. Strength levels may influence the acute response to resistance training due to the ability of stronger participants to exhibit greater resistance to fatigue [31]. In fact, stronger participants show lower levels of fatigue in response to a given stimulus as well as a greater and earlier potentiation enhancement[14] and may are therefore more likely to benefit from a priming exercise performed 6h before. At this stage it is unclear why relative strength did not display the same relationship given this may better account for strength differences between participants. This study included individuals with 'some' resistance training experience, but potential differences in training age, specific type and frequency of participation or even fiber type and genetic factors were not accounted. Therefore, further studies may be able to study relative strength effects more closely in similar demographics (e.g. strength sports athletes) where potential differences in training histories are more uniform.

Additionally, the priming exercise also appeared to positively impact some aspects of subjective readiness. For example, the current results demonstrate higher levels of physical performance capability and activation balance 6h after the priming exercise compared to baseline

(Figure 4). These positive changes in psychological readiness may be mediated attenuated declines of testosterone as part of the usual circadian cycle[32] (as demonstrated after exercise priming[10]) as this hormone is related to self-selected volitional workload in strength and power actions[32]. Thus, resistance priming exercise may positively influence participants self-perception and improve mood[33], which may then contribute, at least in part, to improved performance. Nevertheless, González-García et al.,[7] showed no benefits in any psychological readiness metric using the SRSS after 2 sets of 80% 1RM half squats with a ~20% velocity loss. Despite the null findings by González-García et al.,[7], in the current study the use of 2 sets of ~4 repetitions with the 80%1RM appeared to exert a positive effect on participants´ physical performance capability and activation balance.

We acknowledge that several limitations of the current study exist and warrant further consideration in future research. First, the current study did not perform any hormonal and neurophysiological evaluation and thus, precludes us from identifying if these pathways contribute to delayed performance changes[6]. Second, we only measured priming effects on one performance task, the CMJ. Therefore, we cannot determine whether a squat based priming exercise may be useful for other movements. Thirdly, the current results are based on a cohort of participants with 'some' strength training experience and these results may be different in relatively stronger participants (1RM/BM > 1.6). Additionally, the results and conclusions drawn come from only two days of evaluation. Therefore, it is necessary to identify whether similar responses and variability would occur in other sporting populations given the potential effect that strength (either absolute or relative) may have on delayed performance effects. Finally, trying to implement a priming 6 hours before the competition may impact the athlete's sleep patterns depending on competition time.

Collectively, the results of the present study showed that the use of a high load velocity-loss based priming exercise session did not increase CMJ performance at the group level but did improve psychological readiness 6h after its completion. However, individual responder analysis revealed that 4/14 participants did show a positive performance benefit and that a relationship may exist with absolute, but not relative strength. Coaches and athletes may consider the implementation of low volume, minimally fatiguing high load priming exercises to increase jump performance on the day of competition. Indeed, the implementation of any priming sessions need to be considered in the context of having either potential cross over or conflict with taper periods (in individual sports) and/or appropriate in terms of microcycle structure (regular team sport competition schedules). Given the different individual responses observed, we suggest to first evaluate individual effects outside of the competition period to identify those athletes who may benefit from this strategy, before implementation into a competition preparation setting.

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Table 1. Descriptive characteristics of the priming exercise

	Priming			
	Mean	SD	Range	
			Min	Max
Reps Set 1	4.71	1.20	3	6
Reps Set 2	4.43	0.94	3	6
Fastest Velocity Set 1 (m/s)	0.54	0.08	0.39	0.68
Fastest Velocity Set 2(m/s)	0.54	0.09	0.42	0.68
Slowest Velocity Set 1 (m/s)	0.42	0.07	0.30	0.52
Slowest Velocity Set 2(m/s)	0.43	0.09	0.31	0.58
Velocity Loss Set 1 (%)	21.4	2.9	16.4	26.3
Velocity Loss Set 2 (%)	21.6	3.6	17.5	26.8
RPE	7.43	1.28	5	9

Reps=Repetitions performed in each set; Velocity Loss=Mean percent loss in velocity from the fastest to the slowest repetition in each set; RPE=Rated of Perceived Exertion (0-10). m/s=meters per second; %=percent change.

Table 2. Reliability of the dependent variables

	ICC	CI 95% Lower	CI 95% Upper	SWC
Jump Height [cm]	0.98	0.94	1.00	1.76
RSI-modified [m/s]	0.97	0.89	0.99	0.03
Concentric Mean Power [W]	0.99	0.97	1.00	123.97
Concentric Mean Power / BM [W/kg]	0.98	0.92	0.99	1.10
Concentric Peak Velocity [m/s]	0.99	0.95	1.00	0.06
Eccentric Mean Power [W]	0.93	0.75	0.98	22.19
Eccentric Mean Power / BM [W/kg]	0.90	0.67	0.97	0.25
Eccentric Peak Velocity [m/s]	0.90	0.67	0.97	0.05
Concentric Mean Force [N]	0.99	0.98	1.00	68.69
Concentric Mean Force / BM [N/kg]	0.96	0.86	0.99	0.39
Concentric Impulse [N/s]	1.00	0.99	1.00	9.36
Concentric Impulse-100ms [N/s]	0.97	0.89	0.99	4.89
Eccentric Mean Force [N]	1.00	1.00	1.00	26.70
Contraction Time [ms]	0.91	0.69	0.97	22.12
Concentric Duration [ms]	0.96	0.85	0.99	9.30
Eccentric Duration [ms]	0.89	0.63	0.97	14.95
Countermovement Depth [cm]	0.93	0.77	0.98	1.36

ICC= intraclass correlation coefficient; SWC=smallest worthwhile change; CI95%= 95% confidence interval. cm=centímeters; m/s=meters per second; W=Watts; kg=kilogram; N=newtons; N/s=newtons per second; ms=milliseconds.

Table 3. Differences in CMJ outcomes, kinetics and jump strategy between Priming and Control conditions.

	Priming							Control			
	Mean	95%CI			*p* vs pre	*p* vs Control	*d* vs Control	Mean	95%CI		*p* vs pre
Jump Height [cm]											
Pre	35.79	30.69	40.89			0.622	-0.01	36.01	30.69	41.34	
Post	32.96	28.11	37.82	*#	**0.003**	**0.001**	-0.24	35.44	30.07	40.80	0.232
6h	36.07	30.96	41.18		>0.99	0.700	-0.02	36.21	31.25	41.18	>0.99
RSI-modified [m/s]											
Pre	0.49	0.42	0.57			0.283	0.08	0.48	0.41	0.55	
Post	0.45	0.39	0.51		0.076	0.149	-0.15	0.48	0.40	0.56	>0.99
6h	0.49	0.41	0.57		>0.99	0.143	0.14	0.47	0.39	0.56	>0.99
Concentric Mean Power [W]											
Pre	1984.5	1535.0	2433.9			0.465	0.04	2060.4	1721.8	2398.9	
Post	1870.0	1450.7	2289.3	*#	**0.045**	0.057	-0.15	2077.8	1707.4	2448.2	>0.99
6h	1994.7	1530.8	2458.5		>0.99	0.554	0.04	2054.7	1719.6	2389.8	>0.99
Concentric Mean Power / BM [W/kg]											
Pre	28.13	25.08	31.18			0.240	0.08	27.66	24.72	30.59	
Post	26.39	23.65	29.13	*#	**0.014**	**0.049**	-0.23	27.88	24.53	31.23	>0.99
6h	28.04	24.80	31.27		>0.99	0.301	0.08	27.56	24.54	30.59	>0.99
Concentric Peak Velocity [m/s]											
Pre	2.74	2.55	2.93			0.836	0.00	2.74	2.55	2.94	
Post	2.64	2.45	2.84	*#	**0.005**	**0.001**	-0.23	2.73	2.53	2.93	0.899
6h	2.75	2.56	2.94		>0.99	0.726	-0.02	2.76	2.58	2.94	>0.99
Eccentric Mean Power [W]											
Pre	554.14	483.12	625.16			0.952	-0.03	555.07	488.08	622.07	

Post	554.93	492.54	617.31		>0.99	0.800	0.04	551.79	483.62	619.95	>0.99
6h	549.86	483.96	615.76		>0.99	0.823	0.00	553.36	476.94	629.77	>0.99
Eccentric Mean Power / BM [W/kg]											
Pre	7.55	6.87	8.23			0.942	-0.04	7.56	6.99	8.14	
Post	7.59	7.02	8.16		>0.99	0.693	0.06	7.53	6.94	8.11	>0.99
6h	7.46	6.95	7.98		>0.99	0.829	0.01	7.51	6.79	8.23	>0.99
Eccentric Peak Velocity [m/s]											
Pre	-1.48	-1.62	-1.34			0.829	0.07	-1.49	-1.61	-1.37	
Post	-1.51	-1.64	-1.38		>0.99	0.472	-0.12	-1.48	-1.62	-1.34	>0.99
6h	-1.46	-1.56	-1.36		>0.99	0.409	-0.14	-1.43	-1.57	-1.29	0.499
Concentric Mean Force [N]											
Pre	1,412.3	1,234.5	1,590.1			0.348	0.04	1,399.8	1,215.8	1,583.8	
Post	1,367.9	1,201.8	1,534.0		0.057	0.121	-0.09	1,408.9	1,211.7	1,606.1	>0.99
6h	1,407.8	1,224.9	1,590.7		>0.99	0.237	0.06	1,386.0	1,212.0	1,560.1	>0.99
Concentric Mean Force / BM [N/kg]											
Pre	19.12	18.15	20.10			0.280	0.12	18.91	17.94	19.88	
Post	18.54	17.73	19.34	#	**0.046**	0.158	-0.20	19.01	17.84	20.19	>0.99
6h	18.99	17.91	20.07		>0.99	0.259	0.16	18.70	17.71	19.69	>0.99
Concentric Impulse [Ns]											
Pre	194.53	168.90	220.16			0.396	-0.01	195.83	168.13	223.53	
Post	187.08	160.74	213.42	*#	**0.004**	**0.001**	-0.12	194.27	165.87	222.67	0.257
6h	196.49	169.00	223.97		0.852	0.559	-0.01	196.94	169.98	223.89	>0.99
Concentric Impulse-100ms [Ns]											
Pre	92.64	80.15	105.13			0.127	0.17	88.66	76.23	101.10	
Post	88.16	77.15	99.18		0.526	0.417	-0.10	92.01	77.17	106.85	0.346
6h	90.56	77.95	103.18		>0.99	0.136	0.13	87.64	75.48	99.79	>0.99

Eccentric Mean Force [N]										
Pre	723.50	646.67	800.33		0.813	0.00	723.93	646.34	801.52	
Post	722.57	645.67	799.48	0.546	0.938	0.00	722.71	645.04	800.39	0.124
6h	723.79	647.54	800.03	>0.99	0.709	-0.01	724.64	649.30	799.99	>0.99
Contraction Time [ms]										
Pre	783.14	715.30	850.99		0.517	-0.14	793.93	740.73	847.13	
Post	792.07	737.23	846.91	>0.99	0.924	0.04	789.79	717.87	861.70	>0.99
6h	793.14	737.24	849.05	>0.99	0.207	-0.24	818.36	757.59	879.12	0.808
Concentric Duration [ms]										
Pre	287.00	263.10	310.90		0.234	-0.16	294.14	269.76	318.52	
Post	291.86	269.39	314.32	>0.99	0.966	0.04	291.50	261.96	321.04	>0.99
6h	291.93	270.66	313.19	>0.99	0.157	-0.28	301.93	281.35	322.51	0.75
Eccentric Duration [ms]										
Pre	496.14	447.01	545.27		0.770	-0.12	499.79	466.90	532.67	
Post	500.21	463.31	537.12	>0.99	0.914	0.05	498.29	450.18	546.39	>0.99
6h	501.21	463.62	538.81	>0.99	0.296	-0.18	516.43	471.00	561.86	0.947
Countermovement Depth [cm]										
Pre	-37.92	-41.79	-34.05		0.685	0.12	-38.46	-41.63	-35.30	
Post	-38.66	-42.22	-35.11	>0.99	0.588	-0.10	-37.99	-41.52	-34.45	>0.99
6h	-38.09	-41.49	-34.70	>0.99	0.370	0.16	-39.10	-42.35	-35.85	>0.99

p vs Control= *p* value for pairwise comparison with Control at the same time point after priming exercise. *d*=Cohen´s d; CI95%= 95% confidence interval; cm=centímeters; m/s=meters per second; W=watios; kg=kilogram; N=newtons; Ns=newtons per second; ms=miliseconds. *=significant time effect; #=significant interaction (condition*time) effect

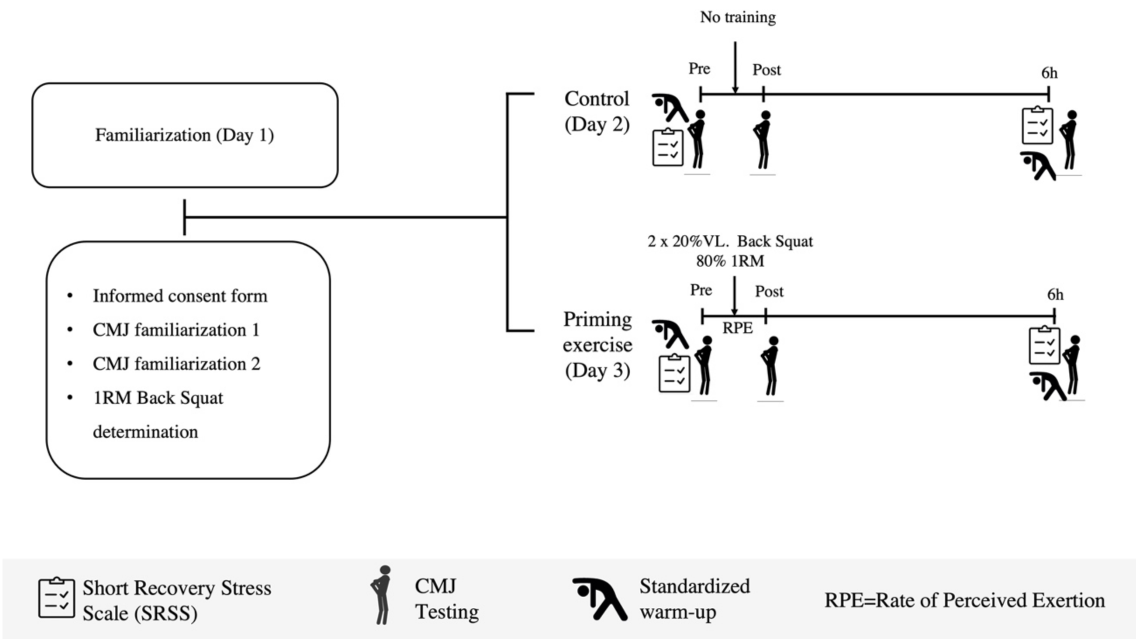

Figure 1. Flow chart of the experimental protocol.

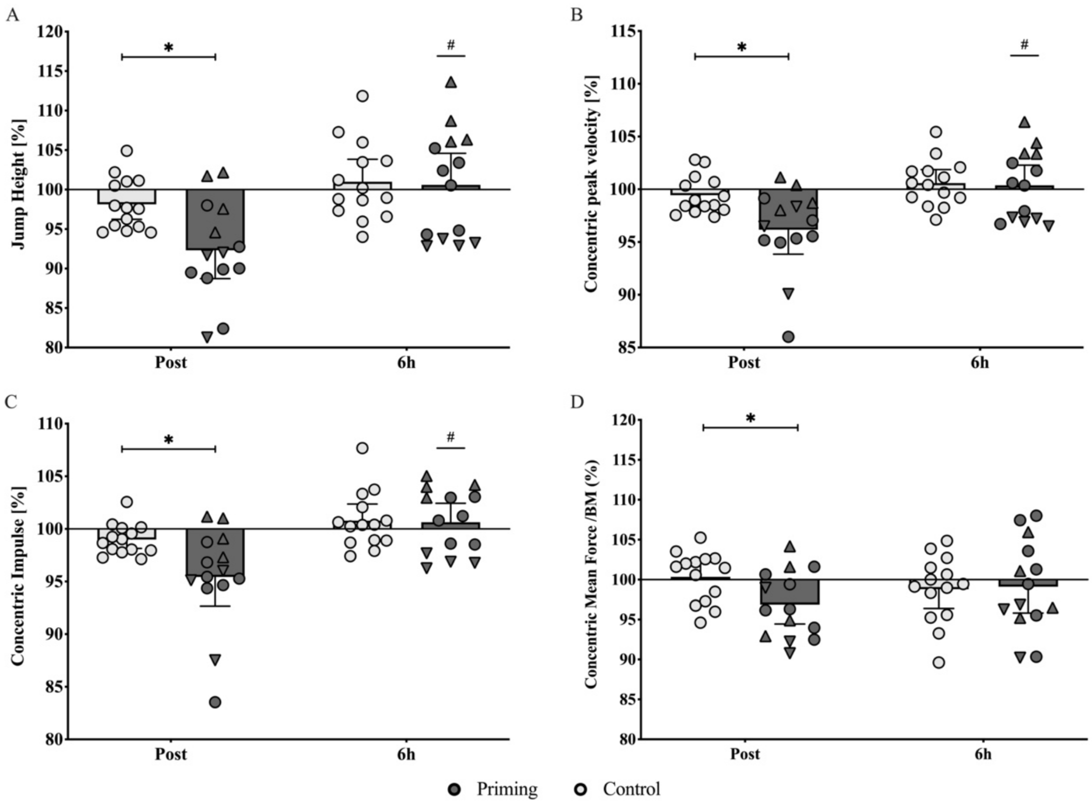

Figure 2. Mean change (bars) and individual changes (shapes) in jump height (panel A), concentric peak velocity (panel B), concentric impulse (panel C) and concentric mean force/BM (Panel D) after experimental conditions (Priming and Control) expresses as a percentage of baseline (y-axis). Responder analysis was calculated using the results for jump height and then other outcome variables for the same participants tracked (see other panels – note: some responders display lower concentric mean force/BM). Upward triangles indicate positive responders, downward triangles indicate negative responders and circles indicate non-responders at the 6h time point. *= Significant differences between conditions at the same time point (p<0.005) #= Significant differences between time point for the same condition (p<0.005)

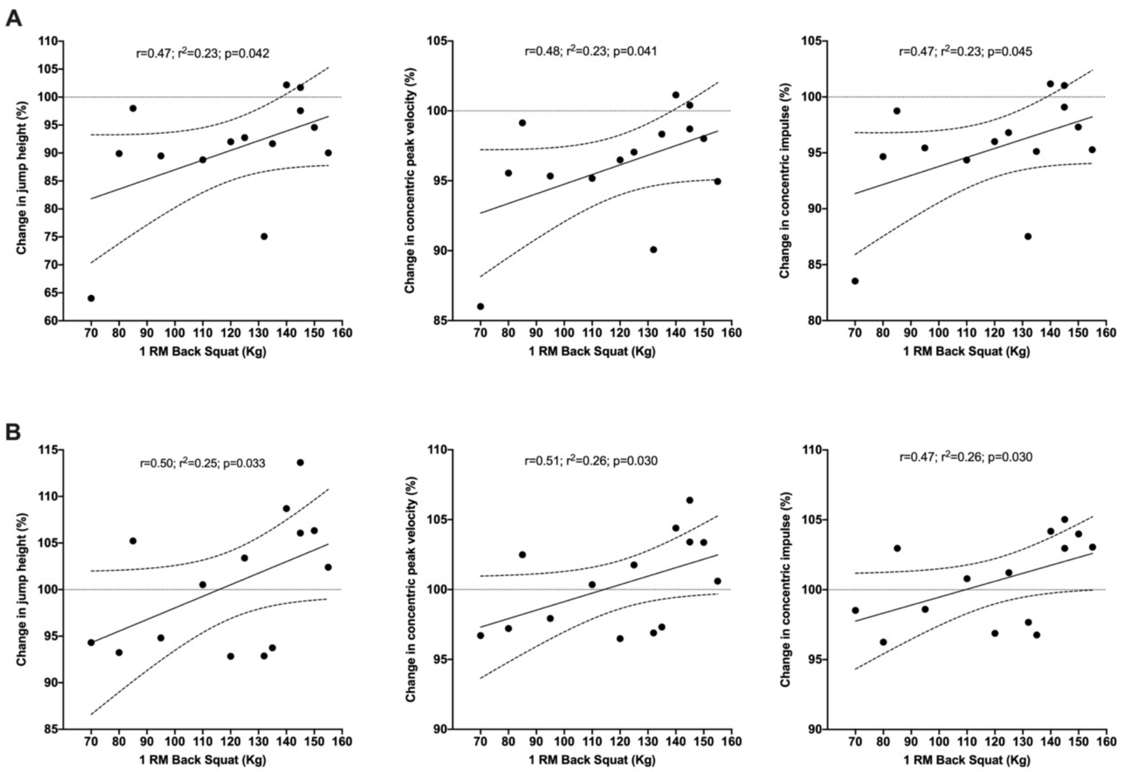

Figure 3. A) Relationship between absolute parallel squat strength and change in CMJ outcomes at post assessment, and **B)** relationship between absolute parallel squat strength and change in CMJ outcomes at 6h assessment.

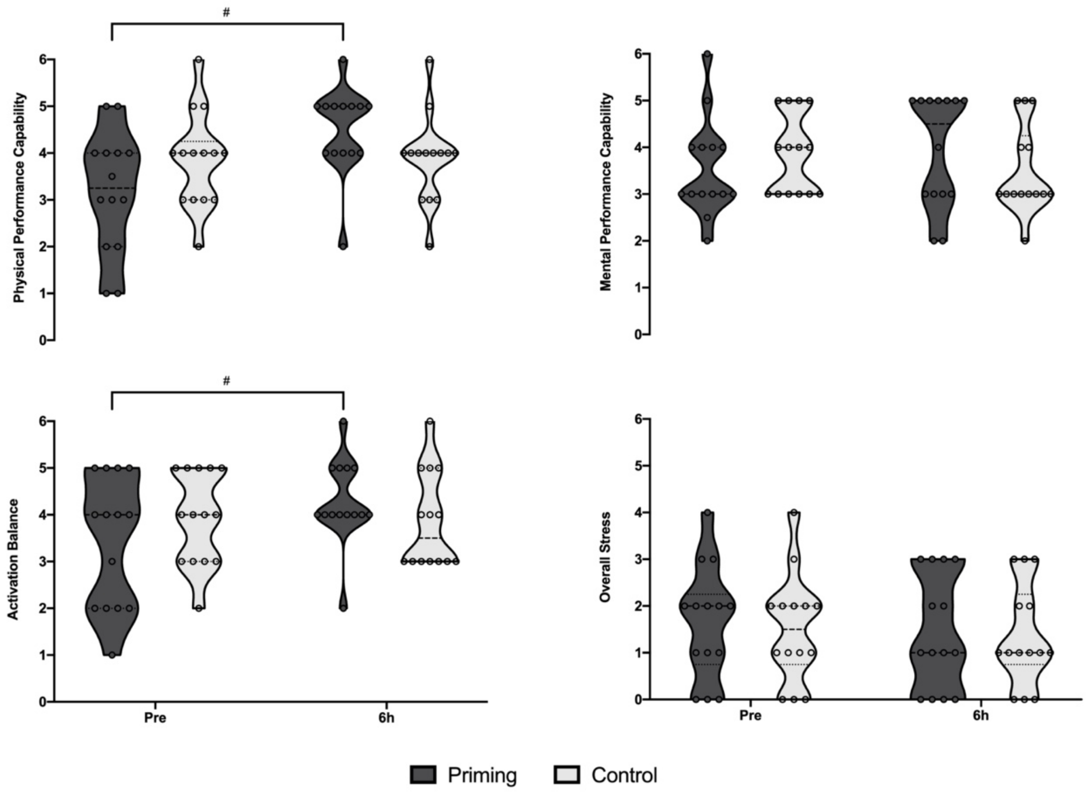

Figure 4. Change in psychological readiness after both experimental conditions (Priming and Control). #= Significant differences between time point for the same condition (*p*<0.005)