The effect of post-match resistance training on recovery in female footballers; when is best to train?

Running head: Resistance training during post-match recovery

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Abstract

This study examined the effects of resistance training (RT) performed at 24 or 48h post-match on the 72h post-match recovery timeline in female soccer players. In a randomized cross-over design, ten professional female soccer players undertook competitive matches followed by three conditions: Control (no RT), RT-24h and RT-48h post-match. RT was a high-speed and low-load session, consisting of 3 sets of 6 repetitions of lower-body exercises at 50% 1RM. During training, one exercise (half-squat) was performed on a force platform to determine mean and peak forces. Testing for recovery status was undertaken pre and 24, 48 and 72h post-match including countermovement jump (CMJ), 20m sprint, C-reactive protein (CRP) and delayed onset muscle soreness (DOMS). Two-way (3x4) repeated-measures ANOVA and Effect size (ES) analyses compared the time-course of recovery. No significant interaction and no significant main effect for condition were evident ($p>0.05$). A main effect for time was observed, with DOMS increased and CMJ performance reduced at 24h post-match, while 20m sprint time was slower up to 72h for all conditions. Despite no significant differences between conditions, ES for changes from pre to 72h were larger for CMJ, 10 and 20m sprint time, and DOMS in RT48h (ES=0.38-2.13) than in RT24h (ES=0.08-0.66) and in Control (ES=0.09-0.36). No differences in mean or peak forces of half-squat exercise existed between conditions ($p>0.05$; ES=0.05-0.06). In conclusion, the trend for suppressed recovery of speed, power and perceptual responses at 72h post-match suggests RT48h is less ideal in female soccer players, particularly during congested micro-cycles.

Keywords: strength; training; performance; fatigue.

INTRODUCTION

During the competitive in-season, soccer players are exposed to a congestion of training and match-play demands, which can increase physical load, resulting in both acute and residual fatigue development[1–3]. In-season micro-cycles can consist of 2-3 matches/week, which reduce the recovery timeline between matches and training[4]. Previous studies report match-related fatigue, with speed and power remaining suppressed until ≈72h post-match[5]. Therefore, during congested micro-cycles, recovery becomes increasingly complex due to fatigue from accumulated match-play coupled with the need to train. Although training has the potential to disturb the recovery process, it is still crucial to maintain physical capacities and avoid the loss of adaptations acquired during pre-season[6,7]. As a result, the use of resistance training (RT) can be sacrificed during competitive micro-cycles due to concerns about the effects of residual fatigue on upcoming matches[8].

Soccer training routines consist of technical-tactical drills, resistance training, strength and power, aerobic and anaerobic endurance exercises[9]. Recent evidence supports the use of RT for soccer athletes to improve maximal strength, jump performance, sprint time, agility and ball strike speed[10–14]. Training programs targeting explosive strength (high-speed with low-resistance) are suggested in this population due to increased force production, acceleration and speed outcomes that are critical to physical performance[15,16]. Such training also hypothetically induces low acute and residual fatigue levels, which is an important consideration for prescription during congested micro-cycles[16–18]. However, the magnitude of fatigue induced by this training method (high-speed and low-load RT) and its effect if performed post-match is rarely quantified. Previous studies investigated the effect of a single RT session (4-6 repetitions per set at 40%1RM) and found only mild muscle damage and inflammatory responses, minimally affecting the performance of simulated tests of soccer skills within 48h in male athletes[19]. Goulart et al.[18] showed a light-load high-speed RT (3 sets of 6 repetitions at 50%1RM) induces only small and immediate decrease in vertical jump performance, without prolonged suppression of recovery parameters in professional female players. However, these studies involved athletes in rested conditions[17–19], making it difficult to extrapolate the results to competitive micro-cycles, where residual fatigue longer than 72-96 h is induced by both training and match-play. As a consequence, reluctance exists in the prescription of RT due to concern about residual effects on speed and power skills related to soccer[8]. Accordingly, there is limited scope to inform the best practice for including RT sessions within a weekly competitive micro-cycle.

Despite the importance of performing RT during the in-season[20], the timing of these post-match sessions remains debatable. Performing RT 24h post-match may potentially increase stress on already fatigued athletes, contrastingly, at 48h post-match it may suppress recovery for any ensuing match at 72h. Further consideration is also required for the quality of any explosive strength training session performed at these times, which may be affected by the proximity to a prior match. Given these circumstances are common during competitive seasons, the investigation into RT in different post-match timelines is important to understand recovery, plan training and prepare players for ensuing matches. Thus, the aim of the present study was to investigate the effect of a high-speed low-load RT session performed 24 or 48h post-match on the 72h recovery time-line of female soccer players.

METHODS

Subjects

Ten Brazilian professional female soccer players (age 25.1±5.9years, body mass 58.9±6.2kg, height 162.0±6.0cm, percent body fat 17.9±3.3%, VO_{2max} 48.8±0.4ml·kg^{-1}·min^{-1}) completed the three experimental conditions. The study was approved by the ethics committee of the Universidade Federal de Minas Gerais, UFMG-Brazil (74974117.3.0000.5149) and all participants provided written informed consent form before participation. All players were affiliated to the Brazilian Football Confederation, trained 5 sessions/week, about 2-3h each session (1-2 RT sessions/week). During data collection, participants were in concurrent championships, with matches on Sundays (regional) and on Wednesdays (national). From the data acquired, no athlete was using oral contraceptives and only one was in menstruation during control condition. Due to that reason, data was biased from one athlete for

C-reactive protein (CRP), which is an acute-phase protein used to infer residual inflammation[21], although it was not excluded for analyses.

Experimental Approach to the Problem

During the pre-season, players were familiarized with all testing procedures, and performed the Yo-Yo intermittent recovery test level 2 during fitness testing[22]. Two testing sessions separated by 5-days were performed to calculate the Intraclass Correlation Coefficient (ICC) and the Standard Error of Measurement (SEM) of physical performance tests. Every two months, the participants performed a test to estimate 1RM corresponding to the exercises of the prescribed RT session. Data collection was undertaken during five official matches from "Taça BH" (Belo Horizonte Youth Cup), with matches held on Sundays at similar starting times.

Pre-match performance tests were collected 2 days prior to the match and physiological and perceptual parameters were collected approximately 1h pre-match. Dependent variables were collected at pre, 24, 48 and 72h post-match. In a within-subjects cross-over design, three experimental conditions were compared: (1)RT performed 24h post-match (RT24h), (2)48h post-match (RT48h) and (3)control condition (Control) without RT (Figure1). At 24h post-match in RT48h and Control conditions, participants only did the test procedures, while players on RT24h performed the RT session after testing. At 48h post-match, all participants completed the test procedures and then players in Control and RT24h had a technical-tactical session with the coach, while players on RT48h performed the RT session. Removal of the technical-tactical session was not possible, and is accepted as an appropriate limitation of an ecologically valid setting. Diet was not explicitly controlled, but prior to matches or training, participants were provided with a dietary plan to consume fruits and isotonic drink.

Procedures

Estimation of 1 Repetition Maximum (RM)

Testing estimated the load corresponding to 1RM of the following exercises: half-squat, deadlift, and lunges. Initially, participants performed a warm-up consisting of 1 set of 6 repetitions of each exercise with the 20kg bar. Then participants chose a weight to perform repetitions until concentric failure. If failure did not occur until the sixth repetition, a new attempt was undertaken at a greater weight. A maximum of 3 attempts existed for each exercise so that the concentric failure occurred before the sixth repetition. The weight and number of repetitions to failure estimated the 1RM[23], as the best estimates of 1RM squat are evident at 80% 1RM load, with a range of 5-17 repetitions to failure in footballers[23]. Due to difficulties to perform a maximal test with the jump squat exercise, the 1RM determined for the half-squat was also used for this exercise.

Match day procedures and load measurement

Participants were weighed pre- and post-match (G-Tech Glass10, China), though players had *ad libitum* water intake during the match, which was not recorded. Participants wore a heart rate (HR) receiver (Firsbeat1425652, Firstbeat Technologies Oy, Finland) to record $\%HR_{max}$, mean and maximal HR. Further, a 5Hz Global Positioning Satellite (QStarz BT-Q1300ST, Qstarz InternationalCo., Ltd., Taiwan) was worn to record total distance and distance covered in different intensities (high: $>18 km \cdot h^{-1}$, moderate: $10\text{-}18 km \cdot h^{-1}$ and low-intensity: $0\text{-}10 km \cdot h^{-1}$)[24]. Environmental temperature and relative humidity were recorded by a digital thermo-hygrometer (TTH100, Incoterm®, Brazil).

Resistance training protocol

All participants had extensive prior familiarity with the training program, consisting of the half-squat, jump squat, deadlift, and lunge exercises, with emphasis on high-speed and high-power training. The movements were performed as quickly as possible, focusing on a rapid hip extension and the concentric phase at maximal intended velocity and eccentric phase in 2s. Three sets of six repetitions were performed at 50% 1RM with 3-min recovery between sets[18,25]. In justifying the current protocol, previous studies have used light-loads high-velocity protocols (4-8 repetitions/set at 45-60%1RM)[11,13,16,18] in soccer players. The RT protocol was performed 24 or 48h post-match, depending on the week corresponding to the experimental condition of each athlete. Further, to compare the forces produced between conditions, as a proxy for the quality of the RT session, all participants performed the first exercise of the session, a half-squat, on a force platform (PLA3–1D-7KN/JBAZb; Staniak; Warsaw, Poland). Sampling rate was set at 400Hz. Max software was used for recording data and Data Acquisition System Laboratory (DASYLab, version11.0) for analyzing data. Mean and peak force for the six repetitions of one set was used for analysis (n=8). The start and end of a repetition was set when the ground reaction force was equivalent to body weight plus bar and resistance weight (system force).

Pre and 24, 48, 72h post-match measures

Performance tests

Participants performed a warm-up consisting of three submaximal countermovement jumps (CMJ). Four maximal CMJ were subsequently performed with a minimum interval of 15s between trials. Jumps were performed on a contact mat (Multisprint®, Hidrofit Ltda, Brazil) and the height estimated by the flight time. The CMJ started from a standing position with the hands fixed to the hips. Participants then jumped as high as possible after a quick movement downward. During flight phase, legs remained straight and the landing was in plantar flexion. Data of the mean of four jumps were analyzed. Values of ICC and SEM corresponded to 0.931 and 0.7cm.

Electronic timing gates (Multisprint®, Hidrofit Ltda, Brazil) were positioned at 0, 10 and 20m and sprint time for 10 and 20m was measured. Two trials were performed with an interval of 2min recovery. Data were reported as mean of trials. Values of ICC and SEM corresponded to 0.640 and 0.050s.

Physiological response

Fingertip blood was collected and drawn into a heparinized capillary tube. CRP was measured immediately after blood collection, with an automatic fluorescent immunoassay analyzer (ICHROMATM Reader, BSVer01 01-2016, South Korea) as an indirect indicator of inflammation.

Perceptual response

Perceptual responses were collected with DOMS being determined in a 0-10 visual analogue scale[26]. Participants were asked to indicate a value in the scale following the question: "How is your pain sensation today?" Participants also provided answers for the following questions: 1) Are you in the menstrual period? 2) If yes, did you use any medicine for cramps? 3) What was the date of the first day of your last menstrual period? 4) Have you used any colic remedy in the past 3 months? 5) Do you use contraception pills?

Statistical analysis

Data are presented as mean and standard deviation. Shapiro-Wilk test was used to verify the data normality. Mauchly's test was consulted and Greenhouse–Geisser correction was applied if sphericity was violated. A Repeated-measures ANOVA was used to compare match loads between conditions. A paired t-test compared the mean and peak forces of the RT sessions. A two-way (3x4) repeated-measures ANOVA was used to verify differences in dependent variables (CMJ, 10 and 20m sprint time, CRP and DOMS) between conditions (RT24h, RT48h and Control) and time (pre, 24, 48 and 72h). Bonferroni post hoc was used when significant differences were found. Significance level was accepted at $\alpha=0.05$ for two-sided tests. Effect size (ES) with 90% confidence intervals were reported based on partial eta squared from ANOVA analyses and Cohen's d for paired comparisons (i.e. between pre and 72h post-match within each condition) to infer the magnitude of recovery. Threshold values for effect size were defined as trivial(<0.2), small(0.2-0.6), moderate(0.6-1.2), large(1.2-2.0) and very large(>2.0)[27]. Data analyses were conducted in Statistical Package for the Social Sciences version18.0 (SPSS, Chicago) and in Graphpad® software (Prism5.0, San Diego, CA, USA).

RESULTS

Mean environmental temperature and humidity during matches were 32.6±4.5°C and 39.2±13.1%, respectively. Mean post-match body mass change was not significantly different (-0.6±0.6, -0.8±0.6 and -0.5±0.5kg) between Control, RT24h and RT48h, respectively (p>0.05). As shown in Table 1, no significant differences and trivial effects (p>0.05; ES=0.03–0.19) existed between conditions for external or internal match load variables.

No significant interaction effect (p=0.134) and no significant main effect for condition (p=0.148) were evident for CMJ (Figure2a); though ES changes from pre to 72h were larger in RT48h than RT24h and Control conditions (Figure3). A significant time main effect was observed for CMJ height (p=0.001), which was reduced at 24h (p=0.015, ES=-0.56,[-0.76,-0.37]), though was not significantly different at 48h (p=0.141, ES=-0.33[-0.52,-0.14]) and at 72h (p=1.000, ES=-0.15[-0.39,0.08]) for all conditions.

No significant interaction (p=0.125) and no significant main effect for condition (p=0.486) was observed for 20m sprint time (Figure2b); though ES changes from pre to 72h tended to be larger in RT48h than RT24h and Control (Figure3). A significant main time effect (p=0.001) was found for 20m sprint time, which was significantly increased at 24h (p=0.001, ES=1.78,[1.42,2.13]), 48h (p=0.001, ES=1.11,[0.81,1.41]) and 72h post-match (p=0.001, ES=0.93,[0.67,1.20]) for all conditions.

A significant interaction (p=0.037) was found for 10m sprint time, which was higher at 24h (ES=0.93,[0.60,1.27]; ES=2.12,[1.52,2.72]), 48h (ES=0.57,[0.10,1.04]; ES=1.75,[1.19,2.31]) and 72h (ES=0.66,[0.29,1.04]; ES=1.63,[1.00,2.25]) for RT24h and RT48h conditions, respectively (Figure2c).

Further, ES changes from pre to 72h tended to be larger in RT48h than RT24h and Control for 10m sprint (Figure3).

No significant interaction (p=0.354) and no significant main effect for condition (p=0.714) existed for CRP (Figure2d). ES changes from pre to 72h tended to be larger in Control than RT24h and RT48h condition for CRP (Figure3). A significant main effect for time (p=0.032) was reported, though no significant differences for paired comparisons were observed due to a correction factor.

No significant interaction (p=0.279) and no significant main effect for condition (p=0.324) was found for DOMS. ES changes from pre to 72h tended to be larger in RT48h than RT24h and Control (Figure3). A significant time main effect (p=0.001) was observed for DOMS, which was significantly increased at 24h (p=0.001, ES=0.17,[-0.51,0.84]), although no differences were observed at 48h (p=0.158, ES=-0.85,[-1.59,-0.10]) and 72h post-match (p=1.000, ES=-1.14,[-2.14,-0.14]) for all conditions (Figure2e).

In regards to training "quality" inferred from half-squat on a force platform , only trivial effects and no significant difference was observed for half-squat peak and mean force (p=0.843, ES=0.06[-0.58,0.69]; p=0.858, ES=0.05[-0.59,0.69]) between RT24h (1624.99±234.17N; 1558.15±194.83N) and RT48h (1639.58±224.80N; 1569.17±192.76N), respectively.

DISCUSSION

The present study compared the 72h post-match time-course of recovery with RT at 24 or 48h post-match in professional female footballers. Despite no significant differences between conditions, larger effects were evident for reduced speed and power performance measures and increased perceptual responses at 72h for RT48h than RT24h or Control. Of note, the absence of training load (Control) promoted the best recovery at 72h, and depending on match loads, prescription of RT may be best implemented at 24h post-match during competitive micro-cycles. Importantly, as similar forces were produced between conditions for the half-squat, the quality of the RT was not dependent on the timing of the session post-match.

Match loads induce fatigue and should be examined initially to provide context to the recovery timeline. Accordingly, internal and external match loads were comparable across all conditions, though were lower than previously reported in other female populations[1], yet resulted in similar residual fatigue profiles across all conditions. Specifically, physical performance was reduced at 24h (CMJ), and 72h (20m sprint). Interestingly, 10m sprint time was slower at 72h only in RT24h and RT48h conditions. Consequently, the temporal profile of physical performance reduction fits the expected trend of post-match fatigue[5]; although perhaps not as exacerbated as previous reports in female players where larger match loads showed CMJ was still reduced at 69h post-match[1]. Given the post-match reduction in speed and power in the current study, inserting a RT session into the 48h post-match window provide ecological context for micro-cycle training prescription and effect of RT on recovery during the post-match.

The current results reveal no significant differences in CMJ between conditions. However, the largest ES (though still small) were evident from pre to 72h in RT48h (ES=-0.38) than in RT24h (ES=0.08) and Control (ES=0.09). Arguably, the ES reported here may not lead to the conclusion that the RT was a major impediment on post-match CMJ recovery. In support, Kesoglou et al.[19] and Goulart et al.[18] found that jump height did not significantly differ after 24-48h following RT. More relevant to football, simulated skill performance (passing and shooting tests) was only decreased immediately following a RT session[17]. However, these studies were performed in rested athletes to conclude that the residual effect of RT lasts less than 24h in soccer players. The present study shows small to moderate negative effects of including RT 48h post-match on the recovery of CMJ in females, which maybe of note during congested scheduling.

Sprint performance is deemed important to successful match performance[28], and was not significantly different between conditions, regardless of RT timing. However, large and very large ES existed in

RT48h for reduced 10m (ES=1.63) and 20m sprint (ES=2.13) performance at 72h. Consequently, this finding could suggest RT48h is the less ideal condition compared to earlier or no additional training if required to compete at 72h. When sprint time was investigated following RT (60 and 80%1RM, velocity loss of 20 and 40%) on physically active males, slower 20m sprint times were observed immediately post-exercise, but not at 24 or 48h[29]. Despite the reported short-term fatigue in speed induced by resistance exercise[29], when RT is added in the post-match context, the reduction in speed performance lasted longer. Thus, considering that soccer matches in congested micro-cycles are usually performed in a 72h-interval, RT48h may be less favorable prescription in competitive micro-cycles to aid optimal recovery. Hence, if match loads were sufficiently tolerable, RT sooner post-match may be more advisable than training later and closer to ensuing matches, though such speculation requires further investigation.

As expected, CRP peaked at 24h post-match for all conditions, though the lack of significant between-condition differences clouds any effect of post-match RT. Draganidis et al.[17] showed higher CRP values at immediately and 24h post-RT; with the high-intensity group (4-6 repetitions per set at 85-90%1RM) showing increased CRP values than the low-intensity group (8-10 repetitions per set at 65-70%1RM), indicating an intensity-dependent effect. Regardless, the match stimulus is likely the main cause of change in CRP[21] and the similarity in external loads between conditions in the current study supports this assumption. One important consideration for studies with females is that CRP is higher during the early follicular phase[30], though only one player reported menstruation during Control condition. Regardless, the RT used in the 48h post-match window did not affect recovery of CRP.

An increased DOMS is expected post-match[1], and was similarly evident 24h post-match in all conditions here. When RT was included in the post-match window, larger ES from pre to 72h existed in RT48h (ES=0.69) than in RT24h (ES=0.25) and Control (ES=-0.11); suggesting a poorer perceived DOMS following RT48h, though with only moderate effects. Correspondingly, and without match context, Draganidis et al.[17] and Kesoglou et al.[19] reported DOMS was elevated immediately[19] and at 24h[17] after a low-intensity RT in males, while Goulart et al.[18] reported no differences for DOMS after a low-load high-speed RT in female players. Therefore, larger perceptual responses at 72h also support that in a competitive micro-cycle, training 24h prior to a match (RT48h) is the less favorable condition compared to RT24h or no additional training.

Data from the forces applied to the ground contribute to a better insight into the explosive performance of RT sessions and may allow inference of the quality of the training session[31]. Evidence shows decrements in rapid muscle force production immediately after a soccer match play[32] and this could have a negative impact on performance in explosive actions due to residual fatigue. However, the current data suggest the interval between match and training session does not affect the RT performance, since no significant differences and only trivial effects for mean and peak force were observed between conditions. Thus, the results on post-match recovery were not influenced by the quality of the RT, but by the timing of each RT.

Whilst this study reports novel best practices for RT within competitive micro-cycles, a noted limitation was the small sample size of female soccer players. The results represent a case study of players from one team thus represent an exploratory study. However, this is an unfortunate issue with ecological valid testing in a professional team during actual competition. Further, a limitation of the present study is that the three experimental conditions were compared between different matches given the knowledge that inter-match variability is expected[1]. However, all the variables describing match demands (heart rate, total, high, moderate and low-intensity distance, number of actions and match duration) were not different between conditions. Moreover, the fact that the participants performed conditions in a random order attempted to minimize the inter-match variability effect. Future studies should investigate the effect of maximum strength protocols in the recovery post-match of female soccer.

In conclusion, despite no significant differences between conditions, performing a high-speed and low-load RT 48h post-match results in small-moderate effects for reduced recovery of power, speed and muscle soreness at 72h post-match than RT24h or Control. Therefore, during competitive micro-cycles and depending on match loads, prescription of RT two days prior to the ensuing match (RT24h) is suggested in order to provide training exposure to this type stimulus, yet ensure appropriate recovery in female soccer players.

PRACTICAL APPLICATIONS

Although the absence of training provided the best recovery profile during competitive micro-cycles, RT24h is suggested to maintain physical capacities. Besides, similar forces during resistance training sessions are obtained 24 or 48h post-match. Thus, low match loads might not impair the quality of a RT, though performing a high-speed low-load RT at least two days prior to the match is recommended for appropriate recovery. However, practitioners should be cautious in interpreting these results due to the exploratory nature of the study and the match loads should be considered for training prescription.

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DISCLOSURE OF INTEREST

The authors report no conflict of interest.

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Table 1. Mean ± SD external and internal match loads for resistance training 24 hours post-match (RT24h), resistance training 48 hours post-match (RT48h) and Control Condition

	RT24h	RT48h	Control	F (df)	p	ES
Time played (min)	76.4 ± 15.9	79.4 ± 15.5	84.0 ± 14.5	1717 (2,18)	0.208	0.160
Total distance (m)	5332.2 ± 1413.7	5565.8 ± 836.0	6043.7 ± 1030.4	0.920 (2,12)	0.425	0.133
High-speed (m)	138.3 ± 246.2	108.6 ± 76.7	133.3 ± 92.7	0.245 (1.09, 6.52)	0.656	0.039
Moderate-speed (m)	760.2 ± 434.8	981.9 ± 368.3	965.8 ± 303.8	1082 (1.12, 6.73)	0.344	0.153
Low-speed (m)	4433.7 ± 1139.3	4475.3 ± 674.3	4944.6 ± 804.9	0.718 (2,12)	0.508	0.107
Number of actions	1178.6 ± 33.8	1164.3 ± 0.7	1203.4 ± 38.7	1476 (2,12)	0.267	0.197
%HR max	83 ± 8	84 ± 6	83 ± 7	0.920 (2,18)	0.416	0.093
HR mean (bpm)	163 ± 18	164 ± 15	167 ± 11	0.884 (2,18)	0.430	0.089
HR max (bpm)	194 ± 12	192 ± 12	193 ± 12	1.245 (2,18)	0.312	0.121

SD= standard deviation, ES= effect size, HR=heart rate, df=degrees of freedom. High speed: >18 $km \cdot h^{-1}$, moderate speed: 10 to 18 $km \cdot h^{-1}$ and low-speed: 0 to 10 $km \cdot h^{-1}$.

FIGURE LEGENDS

Figure 1. Experimental design of post-match recovery with resistance training prescribed at different time points. RT24h= resistance training 24 h post-match; RT48h= resistance training 48 h post-match

Figure 2. Time course of recovery for Countermovement Jump (CMJ), 20m and 10m sprint time, C-Reactive Protein (CRP) and Delay Onset Muscle Soreness (DOMS) at pre, 24h 48h and 72h post-match in Control, RT24h and RT48h conditions.

Values are as mean and standard deviation. A. Countermovement jump; B. 20 m sprint test; C. 10 m sprint test; D. C-Reactive Protein; E. Delay Onset Muscle Soreness. Control= no resistance training, RT24h= resistance training 24 hours post-match, RT48h= resistance training 48 hours post-match.
* represents significantly different from pre for all conditions (time main effect); # represents significantly different from pre for RT24h condition; & represents significantly different from pre for RT48h condition; $p<0.05$, n=10.

Figure 3. Effect size changes from pre to 72 h post-match for all variables in Control, resistance training 24 hours post-match (RT24h) and resistance training 48 hours post-match (RT48h), n=10

Values are effect size (ES) and confidence interval (CI). CMJ = countermovement jump; CRP= C reactive protein; DOMS= delayed onset muscle soreness, Control= no resistance training, RT24h= resistance training 24 hours post-match, RT48h= resistance training 48 hours post-match.