LESS IS MORE? COMPARISON OF TRAINING TO FAILURE TO BUFFER RESISTANCE TRAINING IN RUGBY PLAYERS

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INTRODUCTION: High levels of strength and power are critical towards success in Rugby (Cunningham et al., 2018). Furthermore, the player's size is crucial in overcoming the opponents (Smart, Hopkins, & Gill, 2013). Resistance training (RT) exercises carried to momentary muscle failure had been amply reported to elicit adaptation in both muscle size (Willardson, Norton, & Wilson, 2010) and strength (Schoenfeld et al., 2014) and is currently amply prescribed for rugby players (Corcoran & Bird, 2009). More recently, the practice of training to failure has been questioned in several studies which compared it to other prescription methods and reported it to inhibit adaptation (Carroll et al., 2018; Izquierdo et al., 2006), possibly due to delayed recovery time (Morán-Navarro et al., 2017) and the excessive amount of accumulated fatigue (Nóbrega & Libardi, 2016). Reducing the number of repetitions completed in each set at ta given intensity can increase movement speed and power generated (Pareja-Blanco, Sánchez-Medina, Suárez-Arrones, & González-Badillo, 2017) and could decrease accumulated fatigue and expedite recovery (Carroll et al., 2018). Therefore, this study compares two RT programs, one carrying each set to muscle failure (training to failure, FAIL), the second with a reduced number of repetitions per set (buffer training, BUFF), on lower body measures of the muscle size, strength, power, and athletic performance.

METHODS: Sixteen male rugby union players, all from the same club competing in the Italian Serie B championship (22.5 ± 2.9 yrs, 178.7 ± 7.6 cm, 87.7 ± 9.7 kg) were recruited. The study was approved by the university ethical committee. Due to injury, three players dropped out of the study. The study was conducted during the off-season and employed a parallel-group design. Testing was conducted before (PRE) and one week following the end (POST) of the six-week-long training intervention period. After PRE testing, players were randomly allocated to either one of two counterbalanced groups: FAIL group or BUFF group. Both groups completed three resistance training sessions, one sprint session, and two rugby practices per week.

Squat and Deadlift were executed on the first and third weekly resistance training sessions, the exercise intensity relative to the one repetition maximum (%1RM) and the number of sets performed increased every two weeks. Both groups performed three sets at 75% on weeks one and two, four sets at 80% on weeks three and four, and five sets at 85% on weeks five and six. FAIL group carried each prescribed set to muscle failure and athletes completed, on the first set, ten reps at 75%, eight reps at 80%, and six reps at 85%, either. On the sets following the first, the number of repetitions completed decreased, reaching muscle failure during each set. BUFF group, instead, reduced the number of repetitions performed for each set by half of the number of repetitions performed by FAIL group on the first set. Therefore, athletes in BUFF group performed sets of five reps at 75%, four reps at 80%, and three reps at 85%. Additionally, athletes in both BUFF and FAIL groups performed three times a week four upper body exercises, training prescription was identical between groups. The weekly sprint training session consisted of four 10m sprints, three 20m sprints, and two 30m sprints, with one minute, two minutes and three minutes recovery, respectively. To assess the effects of the two different training protocols players underwent two testing sessions. During the first testing session, lower body measures of muscle size were assessed: through measurement of midthigh circumference, and midthigh skinfold, the athletes were measured while sitting with a tape measure and skinfold caliper, respectively (Housh et al., 1995). CMJ jump height was assessed with an optoelectric system (Optojump, Microgate, Bolzano, Italy), athletes performed two jumps holding a PVC dowel across their shoulders (CMJH) (Glatthorn et al., 2011). Lower body force-velocity profile was assessed in squat exercise (Samozino, Morin, Hintzy, & Belli, 2008). Athletes completed four sets of two reps of a back squat exercise at four incremental loads corresponding to 20%, 40%, 60%, and 80% of the estimated 1RM. The velocity of the barbell was recorded by a linear position transducer (Chronojump, Barcelona, Spain). For each load force output was computed. Maximal power for the force-velocity relationship in the squat was computed by multiplying the theoretical maximal force established for the relationship for the theoretical maximal velocity and then divided by four (Squat Pmax) (Samozino et al., 2008) Subjects' maximal dynamic strength was assessed through a 1RM test in the barbell back squat (Squat 1RM) and the barbell deadlift exercises (Deadlift 1RM). After 72 hours, the subjects underwent to inline sprint and change of direction speed testing on a natural grass turf. For inline sprint testing, players performed two sprints over 10m (Sprint 10m) and then two sprints over 30m (Sprint 30m), (Green, Blake, & Caulfield, 2011). For change of direction speed, the athletes sprinted from a marker set at 15m from the line, crossing a timing gate set at five-meter distance from the line, starting the timer. When the athletes reached the line, they performed a 180° change of direction and sprinted back, crossing again the timing gate set 5m away from the line and stopping the timer (CoD505) (Delaney et al., 2015).

TABLE 1. Descriptive Statistics

	FAIL (n=6)		**BUFFER** (n=7)	
	PRE	POST	PRE	POST
Midthigh Circumference (cm)	60 ± 1.6	59.1 ± 2.4	59.9 ± 3.6	59.8 ± 3.9
Midthigh Skinfold (mm)	16.6 ± 8.1	18.1 ± 7.8	22.6 ± 9.2	22.7 ± 9.9
CMJH (m)	0.37 ± 0.05	0.38 ± 0.04	0.36 ± 0.05	0.37 ± 0.06
Squat Pmax (W)	1352 ± 210	1412 ± 201	1340 ± 114	1471 ± 205
Squat 1RM (kg)	124.2 ± 13.2	128.3 ± 10.8	126.4 ± 25.8	135.7 ± 27.8
Deadlift 1RM (kg)	153.3 ± 14.7	159.2 ± 12	165 ± 14.7	173.6 ± 16.5
Sprint 10m (s)	1.84 ± 0.06	1.88 ± 0.04	1.87 ± 0.06	1.86 ± 0.06
Sprint 30m (s)	4.43 ± 0.1	4.51 ± 0.06	4.41 ± 0.23	4.43 ± 0.21
CoD505 (s)	2.47 ± 0.13	2.39 ± 0.16	2.54 ± 0.11	2.43 ± 0.08

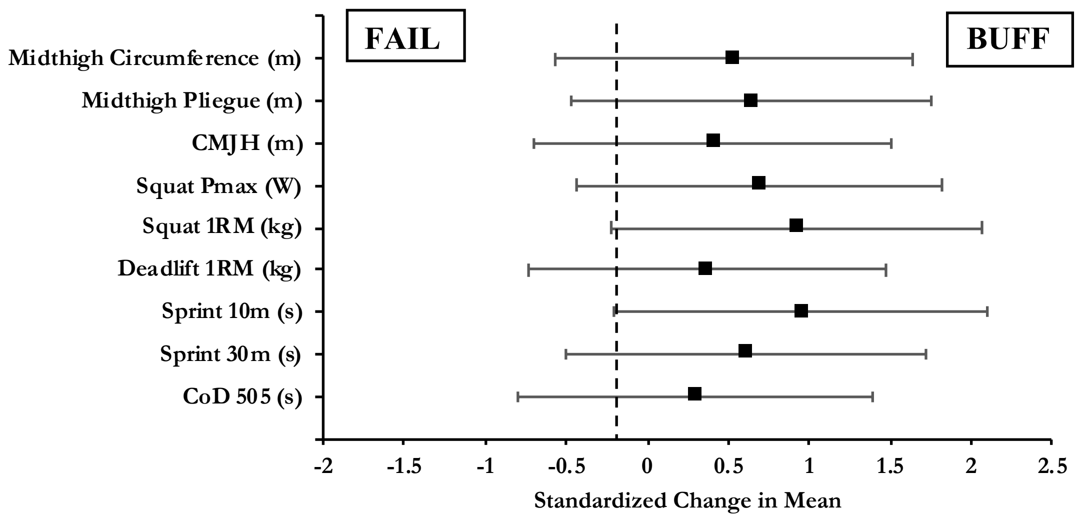
Notes: Data is shown as mean ± standard deviation. FAIL = training to failure, BUFF = buffer training.

Subjects were allowed three minutes recovery period between trials. During the training intervention, volume load (load x number of repetitions performed) was recorded for each training session.

Statistical Analysis: Multiple ANOVA mixed model tests were employed for each dependent variable. TIME (PRE/POST) was the within-subjects factor, GROUP (FAIL/BUFF) the between-subjects factor. Post-hoc testing used Bonferroni-Holm correction. Furthermore, between-groups effect sizes using Cohen's d (ES=[(POST BUFFER–PRE BUFFER)–(POST FAIL–PRE FAIL)]/pooled standard deviation) were computed. ES magnitude was assessed with the following criteria: trivial<0.2, small<0.5, medium<0.8, large>0.8. Unpaired Student's T-test was conducted on volume load. Alpha was set at 0.05. All analyses were conducted using SPSS 21 (IBM, Chicago, USA) and filtered into a customized spreadsheet (Excel, Microsoft, Redmond, USA).

RESULTS: Descriptive statistics for dependent variables are shown in Table 1. No statistical differences between groups for dependent variables were present at PRE testing. The volume load was significantly greater for the FAIL group compared to BUFF (T_{11}=10.37, p=0.0000005). No statistically significant difference was assessed for interaction effect (TIMExGROUP). Effect of TIME reached statistical significance for Squat Pmax ($F_{1,11}$=11.72, p=0.006), Squat 1RM ($F_{1,11}$=18.79, p=0.001), Deadlift 1RM ($F_{1,11}$=14.653, p=0.003), and CoD 505 ($F_{1,11}$ = 14.653 p =0.003). No statistically significant difference was assessed for GROUP. Post hoc analysis assessed statistical differences for TIME for Deadlift 1RM in FAIL group (p=0.034), in Squat Pmax (p=0.032), Squat 1RM (p=0.0004), Deadlift 1RM (p=0.045) and CoD505 (p=0.025) in BUFF Group. ES are reported in Figure 1.

FIGURE 1. Between Group Effect Size



Notes: Forest plot showing effect sizes with 95% confidence interval. While a shift to the left indicates training adaptations more favorable to failure training over buffer training, a shift to the right favors buffer training over training to failure. CMJH = Countermovement Jump Height, Squat Pmax = Maximal power computed for force-velocity relationship in squat exercise, CoD 505 = Change of Direction sprint over 5m, FAIL= Training to failure, BUFF=Buffer Training.

DISCUSSION: The main finding from this study is the lack of statistically significant differences for any of the dependent variables between FAIL and BUFF groups. Furthermore, a practical interpretation of the results through ES suggested that the BUFF group achieved superior training adaptations in power and sprint performances. These findings are coherent and expand to a team sport environment reported by Carroll and colleagues (Carroll et al., 2018). In that study, equal or inferior gains in Maximal Strength, Power and Speed were reported for the FAIL group compared to a relative intensity for set and reps training group in well-trained subjects. Volume load was not different between groups, conversely, in this study, it was substantially larger in the FAIL group. This difference in volume load can suggest a superior training efficiency of the BUFF training prescription method when limiting the amount of work the athletes are capable of accomplishing.

CONCLUSIONS AND PRACTICAL APPLICATIONS: Due to the reduced volume load and greater between groups' effects on performance outcomes, buffer resistance training is a viable prescription method for improving performance in team sport athletes.

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