

Effects of In-Season Velocity- Versus Percentage-Based Training in Academy Rugby League Players

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Purpose: To compare the effects of velocity-based training (VBT) vs percentage-based training (PBT) on strength, speed, and jump performance in academy rugby league players during a 7-wk in-season mesocycle. **Methods:** A total of 27 rugby league players competing in the Super League U19s Championship were randomized to VBT ($n = 12$) or PBT ($n = 15$). Both groups completed a 7-wk resistance-training intervention (2x/wk) that involved the back squat. The PBT group used a fixed load based on a percentage of 1-repetition maximum (1-RM), whereas the VBT group used a modifiable load based on individualized velocity thresholds. Biomechanical and perceptual data were collected during each training session. Back-squat 1-RM, countermovement jump, reactive strength index, sprint times, and back-squat velocity at 40–90% 1-RM were assessed pretraining and posttraining. **Results:** The PBT group showed likely to most likely improvements in 1-RM strength and reactive strength index, whereas the VBT group showed likely to very likely improvements in 1-RM strength, countermovement jump height, and back-squat velocity at 40% and 60% 1-RM. Sessional velocity and power were most likely greater during VBT compared with PBT (standardized mean differences = 1.8–2.4), while time under tension and perceptual training stress were likely lower (standardized mean differences = 0.49–0.66). The improvement in back-squat velocity at 60% 1-RM was likely greater following VBT compared with PBT (standardized mean difference = 0.50). **Conclusion:** VBT can be implemented during the competitive season, instead of traditional PBT, to improve training stimuli, decrease training stress, and promote velocity-specific adaptations.

Keywords: velocity-based training, load–velocity relationship, training load, competitive season, resistance training

Resistance training is an integral component of long-term athlete development in a rugby league. Regular engagement in resistance training induces marked neurological, musculoskeletal, and morphological adaptations that are important for successful rugby league performance.^{1,2} However, acute bouts of resistance exercise can lead to considerable neuromuscular fatigue lasting up to 72 hours.³ This is particularly problematic for rugby league players during the competitive season because excessive fatigue may impair match performance.⁴ Therefore, it is important to carefully regulate training load during this period.

The traditional approach to prescribing resistance-training load is to use a percentage of 1-repetition maximum (1-RM), known as percentage-based training (PBT). Using this method, the external load is fixed until the 1-RM assessment is repeated, usually at the end of a mesocycle. Although PBT has been shown to be effective for improving surrogate measures of rugby league performance,^{5–7} it is not sensitive to the athlete's daily readiness to train. Maximal strength can fluctuate on a day-to-day basis or change throughout the training block.⁸ Consequently, prescribing loads based on percentage 1-RM can lead to a suboptimal training stimulus.

The recent development of portable kinematic devices has enabled practitioners to obtain instantaneous measurements of barbell velocity.⁹ As a result, velocity-based training (VBT) has

become a popular method of regulating resistance-training load. VBT is characterized by lifting with maximal intended velocity and adjusting training load based on the resultant velocity data. A decline in barbell velocity is representative of neuromuscular fatigue,¹⁰ whereas greater velocity attained against a given absolute load may indicate enhanced muscle strength.¹¹ Therefore, VBT can be used to manipulate training load according to the athlete's current physiological state.

Although several VBT approaches exist, recent research has encouraged the use of individualized load–velocity relationships.^{12–14} This method involves obtaining concentric velocity data across the loading spectrum and establishing velocity thresholds at each relative load, which are then used to modify subsequent training load. Dorrell et al¹⁵ recently reported that 6 weeks of prescribing training load based on generalized velocity zones led to greater improvements in countermovement jump (CMJ) height than PBT in 16 recreationally trained men. However, the use of general velocity thresholds does not account for the large interindividual heterogeneity in load–velocity relationships.¹² In addition, no study has compared VBT with PBT in sportspeople during the competitive season, which is arguably where VBT could have the greatest application. Therefore, the purpose of this study was to compare the effects of VBT versus PBT on strength, speed, and jump performance in semiprofessional academy rugby league players during the competitive season. Sessional kinematic, kinetic, and perceptual data were also compared between groups.

Methods

Participants

Academy rugby league players were recruited from one English Super League club during the second half of the competitive

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season. All players were free from injury, were currently competing in the Super League U19s Championship, and had competed a 12-week preseason training block prior to entering the study. In addition, all participants had at least 2 years of resistance-training experience as part of a Super League U15 to U16s Scholarship squad. Participants were informed of the experimental procedures before giving written informed consent, and parental/guardian consent was obtained for participants aged <18 years. Ethical approval for the study was granted by the Cross-School Research Ethics Committee at York St John University in line with the Declaration of Helsinki.

Experimental Design

This study used a parallel group randomized design. Participants were randomly allocated (1:1) to 7 weeks of either VBT or PBT in block sizes of 4 using online randomization software. Both groups completed 2 resistance-training sessions per week that involved the back squat. VBT involved adjusting back squat load using real-time velocity feedback, whereas PBT involved a fixed load based on baseline 1-RM. Outcomes of strength, speed, and jump performance were assessed at baseline (before randomization) and post-intervention endpoint. Biomechanical and perceptual data were also collected during each training session.

Procedures

Participants completed performance testing on 3 separate days, with 24 to 48 hours recovery between each day. Day 1 involved a CMJ, a drop jump (DJ), and a 30-m linear sprint. Day 2 involved a 1-RM test, and day 3 involved an assessment of load-velocity relationships. In the following training week, participants were randomly assigned to PBT or VBT and began the 7-week training mesocycle. After the completion of the final resistance-training session, testing for outcome measures was repeated in the next training week.

Outcome Measures

1-Repetition Maximum. Participants completed 1-RM testing in the free-weight back squat using methods described previously.⁹ Briefly, participants performed a standardized warm-up followed by 5 repetitions at ~50% 1-RM, 3 repetitions at ~70% 1-RM, and 2 repetitions at ~80% 1-RM. Thereafter, participants performed 1-RM attempts with progressively increased loads. Participants were required to achieve a parallel squat depth (thigh parallel to the floor), which was monitored by a member of the research team. A maximum of 5 attempts were permitted, and the last successful lift was taken as the 1-RM.

Individualized Load-Velocity Relationships. A linear position transducer (GymAware PowerTool [GYM]; Kinetic Performance Technologies, Canberra, Australia) was used to measure mean velocity (MV) in the free-weight back squat. Following the same standardized warm-up performed in the 1-RM assessment, participants completed 3 repetitions at 40%, 3 repetitions at 60%, 2 repetitions at 80%, and 1 repetition at 90% of baseline 1-RM. GYM has been shown to obtain reliable measurements of MV at 40% to 90% 1-RM.⁹ Participants were verbally encouraged to complete each repetition with maximal concentric velocity, although objective velocity feedback was not provided. Three minutes of rest was provided between each relative load. Individualized load-velocity relationships were constructed by plotting MV against load and applying a line of best fit.¹³ The MVs corresponding to 60% and

80% 1-RM were used to modify training load in the VBT group. At postintervention, load-velocity relationships were constructed with the same absolute loads used in the baseline assessment.

Sprint Performance. Following a dynamic warm-up and one practice of 30-m sprint, participants completed 2 maximal 30-m sprints, with times being recorded at 5-, 10-, 20-, and 30-m intervals using a photocell timing system (Witty Timing System; Microgate, Bolzano, Italy). Three minutes of rest was provided between efforts. Reliability for each sprint distance was high (coefficient of variations = 2.0–4.5%). All sprints took place on the same outdoor 4G artificial turf and began from a standing start. The fastest sprint was used for analysis.

Jump Performance. Countermovement jump and DJ tests were administered indoors using the Optojump photocell system (Optojump; Microgate), which samples at 1000 Hz and consists of 2 dual-beam bars (100 × 4 × 3 cm) that were placed in parallel approximately 1-m apart.¹⁶ For the CMJ, participants placed their hands on their hips and descended downward to a self-selected level before jumping upward for maximum height. For the DJ test, participants stepped off a standardized box (height, 30 cm) with their preferred leg, landed on the floor with both feet, and immediately jumped as high as possible. Participants received instructions to maintain their hands on their hips, to keep their legs as straight as possible on contact with the ground, and to minimize ground contact time. Three CMJs and DJs were performed, with the highest jump (in centimeters) and reactive strength index (jump height [in meters]/contact time [in seconds]) used for analysis, respectively. Sixty seconds of rest was provided between each jump. Coefficient of variations for CMJ height and RSI were 2.7% and 8.0%, respectively.

Exercise Responses. Participants completed a perceived wellness questionnaire prior to every resistance-training session. The questionnaire included 5 items (muscle soreness, fatigue, stress, sleep, and mood) on a 7-point Likert scale ranging “very bad” to “great.” Higher scores indicated better perceived wellness. Rating of perceived exertion (RPE) data were collected after the completion of every set using the OMNI Perceived Exertion Scale for Resistance Exercise.¹⁷ All participants were familiarized with the scale during prior training sessions, and the scale was always in full view. MV, mean power (MP), time under tension (TUT), work, and barbell load of each back squat repetition were also recorded.

Training Routine

Resistance-training sessions were completed on a morning (7:00 AM), with field sessions (rugby league skills and conditioning) taking place in the afternoon of the same day (4:30 PM). An additional low-intensity field session (“team run”) was performed 24 hours before a competitive match. Furthermore, participants completed a training session that focused on active recovery and general motor ability approximately 48 hours after a match (Figure 1). Each resistance-training session began with a standardized warm-up followed by 4 sets of 5 free-weight back squat repetitions, separated by 2 to 3 minutes of interspersed rest periods. The PBT group performed back squats with a fixed load based on their baseline 1-RM, whereas the VBT group performed back squats with a modifiable load based on a target velocity threshold established from individualized load-velocity relationships. Both groups received the same encouragement to lift with maximal intended concentric velocity and complete the eccentric phase in a controlled manner, although neither group received instantaneous

velocity information to control for the effect of feedback.¹⁸ Following back squats, participants then completed the same 4 supplementary exercises (Nordic lower/Romanian deadlift, upper-body push, upper-body pull, antiextension) using a body weight or repetitions in reserve approach to adjust load (Table 1).

Percentage-Based Training. In the first weekly session, the PBT group performed back squats with 80% of baseline 1-RM, while the second weekly session was performed with 60% 1-RM. These loads were chosen because they are regularly prescribed in strength programs, they target distinct physical qualities on the strength–velocity continuum, and velocity data attained at these loads are reliable.⁹ The barbell load was not adjusted during the 7-week mesocycle.

Velocity-Based Training. Participants in the VBT group performed 1 weekly session with a load that corresponded to MV at 80% 1-RM established from their individual load–velocity relationship. The second weekly session was completed with a load corresponding to MV at 60% 1-RM. The load for the first set of session 1 and the first set of session 2 were 80% and 60% 1-RM, respectively. Thereafter, if the maximum MV in a set of 5 repetitions was ± 0.06 m/s outside of the target movement velocity, the barbell load was then adjusted by $\pm 5\%$ 1-RM for the subsequent set. A threshold of ± 0.06 m/s was chosen based on the measurement error in MV obtained by GYM⁹ and to align with previous research.¹³ Training load was modified based on the maximum MV in a set (rather than mean MV) because load–velocity relationships were constructed with the maximum value.

Data Analysis

Exercise responses to back squats at 60% 1-RM were analyzed separately to responses at 80% 1-RM. All biomechanical data were collected during the concentric phase. The placement of GYM and the methods used to calculate MV and MP have been described previously.^{9,19,20} Work was determined as the area underneath the force–displacement curve during the concentric phase of each repetition, and TUT represented the time spent during the same period. Data obtained from GYM were transmitted via Bluetooth to a tablet (iPad; Apple Inc, Cupertino, CA) using the GymAware (v2.1.1) app and uploaded onto a cloud-based system. Body mass and barbell load were entered into the app prior to each set. MV, TUT, work, and barbell load were determined as the average of all repetitions for each individual across the training intervention. Perceived wellness and RPE were also determined as the average of all data collected during the intervention to reduce the number of statistical comparisons made.

Statistical Analysis

Data were analyzed using Microsoft Excel (Microsoft Corp, Redmond, WA) spreadsheets.²¹ Participants were required to attend

$\geq 70\%$ of resistance-training sessions to be included in the analyses. A magnitude-based inference approach was used to assess the magnitude of effects within and between groups, which interprets the mean differences and their corresponding 90% confidence intervals (CIs) in relation to the smallest worthwhile change (SWC).²² The SWC was considered to be 0.2 times the SD at baseline.²³ Standardized mean differences (SMDs) from preintervention to postintervention were calculated using the formula: mean change/baseline SD, which was divided by $(1 - 3/[4df - 1])$ to adjust for a small sample size. Values of <0.2 , 0.2 to 0.59, 0.6 to 1.19, and 1.2 to 2.0 were considered trivial, small, moderate, and large effects, respectively.²⁴ SMDs in change scores, sessional MV, MP, and barbell load were compared between groups using baseline values as covariates. Covariates were not used to compare RPE, TUT, work, nor perceived wellness. Effects that favored VBT are reported as positive SMDs, whereas effects that favored PBT are reported as negative SMDs. The qualitative probabilities that the magnitude of effect was greater than the SWC were rated as $<0.5\%$ (most unlikely), $<5\%$ (very unlikely), $<25\%$ (unlikely), 25% to 75% (possibly), $>75\%$ (likely), $>95\%$ (very likely), $>99.5\%$ (most likely).²¹ Data are presented as mean (SD) or SMD $\pm 90\%$ CI.

Table 1 Summary of Resistance-Training Sessions During the 7-Week Mesocycle

Exercise	Sets $\times$ reps	Load
Session 1		
Barbell back squat	4 $\times$ 5	PBT: 80% 1-RM VBT: load that corresponds to movement velocity at 80% 1-RM
Nordic lower	4 $\times$ 6	Body weight
Incline dumbbell bench press	3 $\times$ 8	2 RIR
Barbell bent-over row	3 $\times$ 8	1 RIR
Front plank	2 $\times$ 60 s	Body weight
Session 2		
Barbell back squat	4 $\times$ 5	PBT: 60% 1-RM VBT: load that corresponds to movement velocity at 60% 1-RM
SL barbell Romanian deadlift	4 $\times$ 6	2 RIR
Dumbbell push press	3 $\times$ 6	2 RIR
Pull-ups	3 $\times$ 8	1 RIR
Barbell rollout	2 $\times$ 10	2 RIR

Abbreviations: 1-RM, 1-repetition maximum; reps, repetitions; PBT, percentage-based training; RIR, repetitions in reserve; SL, single-leg; VBT, velocity-based training.

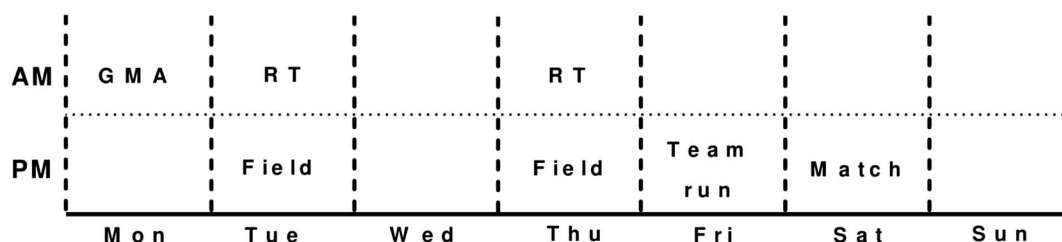


Figure 1 — Weekly in-season training schedule during the 7-week mesocycle. GMA indicates general motor ability; RT, resistance training.

Results

Thirty-two players were initially recruited, although 5 withdrew due to leaving the club ($n=3$) or suffering an injury during a competitive match ($n=2$). Therefore, 27 participants completed the intervention (Table 2). Compliance was 86% in the PBT group and 90% in the VBT group.

Exercise Responses

Relative to the 60% and 80% 1-RM sessions in the PBT group, average loads in the VBT group were 62% and 79% 1-RM, respectively. Sessional MV and MP were most likely greater during VBT compared with PBT (Figure 2), whereas TUT and perceived training stress were likely lower (Figure 3). Compared with the PBT group, VBT elicited likely higher RPE at 60% 1-RM, but likely lower RPE at 80% 1-RM (Figure 2).

Performance Outcomes

The PBT group showed likely to most likely improvements in 1-RM strength and RSI, whereas the VBT group showed likely to very likely improvements in 1-RM strength, CMJ height, and back squat MV at 40% and 60% 1-RM (Table 3). The improvement in back squat MV at 60% 1-RM was likely greater following VBT compared with PBT ($SMD=0.50$). Both groups showed reductions in sprint performance (Table 3), although the change in 10-m sprint time possibly favored the PBT group ($SMD=-0.21 \pm 0.40$). All other SMDs in change scores between groups were likely trivial or unclear (Figure 4).

Discussion

The main finding was that VBT promoted greater sessional MV and MP compared with conventional PBT, whereas TUT and perceived stress were lower. The improvement in back squat velocity attained against 60% 1-RM was also greater following VBT compared with PBT. Therefore, VBT could be implemented during the competitive season to increase back squat repetition velocity, minimize lower-body mechanical stress, and promote velocity-specific adaptations.

Sessional MV and MP were most likely greater during back squats in the VBT group compared with PBT group (SMDs: 1.8–2.4). In addition, concentric TUT and perceived training stress were likely reduced in the VBT group, while differences in concentric work were unclear. This finding agrees with previous research showing that, at the cross-sectional level, prescribing training load based on individualized load–velocity profiles yielded greater MV ($SMD=1.05$), similar total work, and less TUT compared with

PBT during 5 sets of 5 back squats.¹³ Others have also shown that limiting velocity loss during a set leads to higher MV during 6 to 8 weeks of back squat training in resistance-trained males²⁵ and professional soccer players.²⁶ Hence, our findings extend those of previous studies by showing that VBT enhances lower-body training stimuli while minimizing training stress during a competitive rugby league mesocycle.

The improvement in back squat velocity at 60% 1-RM was likely greater following VBT compared with PBT ($SMD=0.50$). The uncertainty of the SMD (90% CI, -0.16 to 1.16) shows that differences compatible with the data range from a trivial effect to a moderate effect favoring VBT. Hence, adjusting training load based on velocity feedback, rather than a percentage of 1-RM, has negligible negative effects but potentially moderate benefits on back squat velocity at 60% 1-RM. This favorable shift in the load–velocity relationship ostensibly resulted from the higher training velocities elicited by VBT and represents an improvement in explosive strength. Explosive strength is the ability to maximize force in minimal time and is often a key objective of strength and conditioning programs because many rugby league actions require force to be applied quickly. However, it is unknown whether this adaptation is exclusive to the back squat or whether it could also transfer to enhanced rugby league match play.

Both groups comparatively improved 1-RM strength. In addition, although the difference in CMJ height favored VBT (0.28 ± 0.61), the effect estimate was small and the precision of the estimate was low, leading to an unclear difference between groups. Thus, VBT did not provide additional benefit over PBT for these outcomes, which can be explained by training specificity. Back squats at 60% and 80% 1-RM are performed at moderate to slow velocities, respectively, and training with these loads will produce the greatest gains in strength at moderate to slow velocities.²⁷ As a result, the higher sessional MV elicited by VBT at 60% and 80% 1-RM is unlikely to lead to further improvements in 1-RM strength or jumping performance, which represent 2 extremes of the load–velocity continuum. These results suggest that either PBT or VBT can be utilized when maximal lower-body strength or explosive jump performance is the primary training objective.

Sprint performance decreased in both groups, which may have been because the 7-week mesocycle did not include any linear sprint training nor horizontally loaded resistance exercises. Previous research has shown that sprint performance does not improve during a rugby league season, despite regular speed training.²⁸ Sprint times have also been shown to worsen in international rugby union forwards during the second half of the competitive season, which was attributed to accumulated match fatigue.²⁹ Thus, a lack of specific training could have combined with residual fatigue to impair sprint performance. Surprisingly, the change score in 10-m sprint time possibly favored PBT ($SMD=-0.21 \pm 0.40$). However, this finding was presumably due to chance variation and/or noise given the 90% CI touched the upper boundary of the SWC and the direction of SMDs in 5-, 20-, and 30-m sprint times actually favored the VBT group (Figure 4).

An interesting finding was that VBT elicited likely higher RPE at 60% 1-RM ($SMD: 0.65$), but likely lower RPE at 80% 1-RM ($SMD: -0.67$). The higher RPE at 60% 1-RM may be related to possibly greater barbell load ($SMD: 0.35$), given the direct relation between RPE and load,³⁰ although unclear differences were found in concentric work. Relative to the 60% and 80% 1-RM sessions in the PBT group, the average loads in the VBT group were 62% and 79% 1-RM, respectively. Hence, players in the VBT group increased sessional MV more when

Table 2 Baseline Characteristics, Mean (SD)

	PBT (n = 15)	VBT (n = 12)
Age, y	17 (1)	17 (1)
Body mass, kg	84.9 (11.9)	81.8 (11.9)
Stature, cm	181 (6.3)	178 (5.3)
Back squat 1-RM		
Absolute, kg	136 (16.6)	137 (18.5)
Relative	1.61 (0.16)	1.69 (0.19)

Abbreviations: 1-RM, 1-repetition maximum; PBT, percentage-based training; relative, relative to body mass; VBT, velocity-based training.

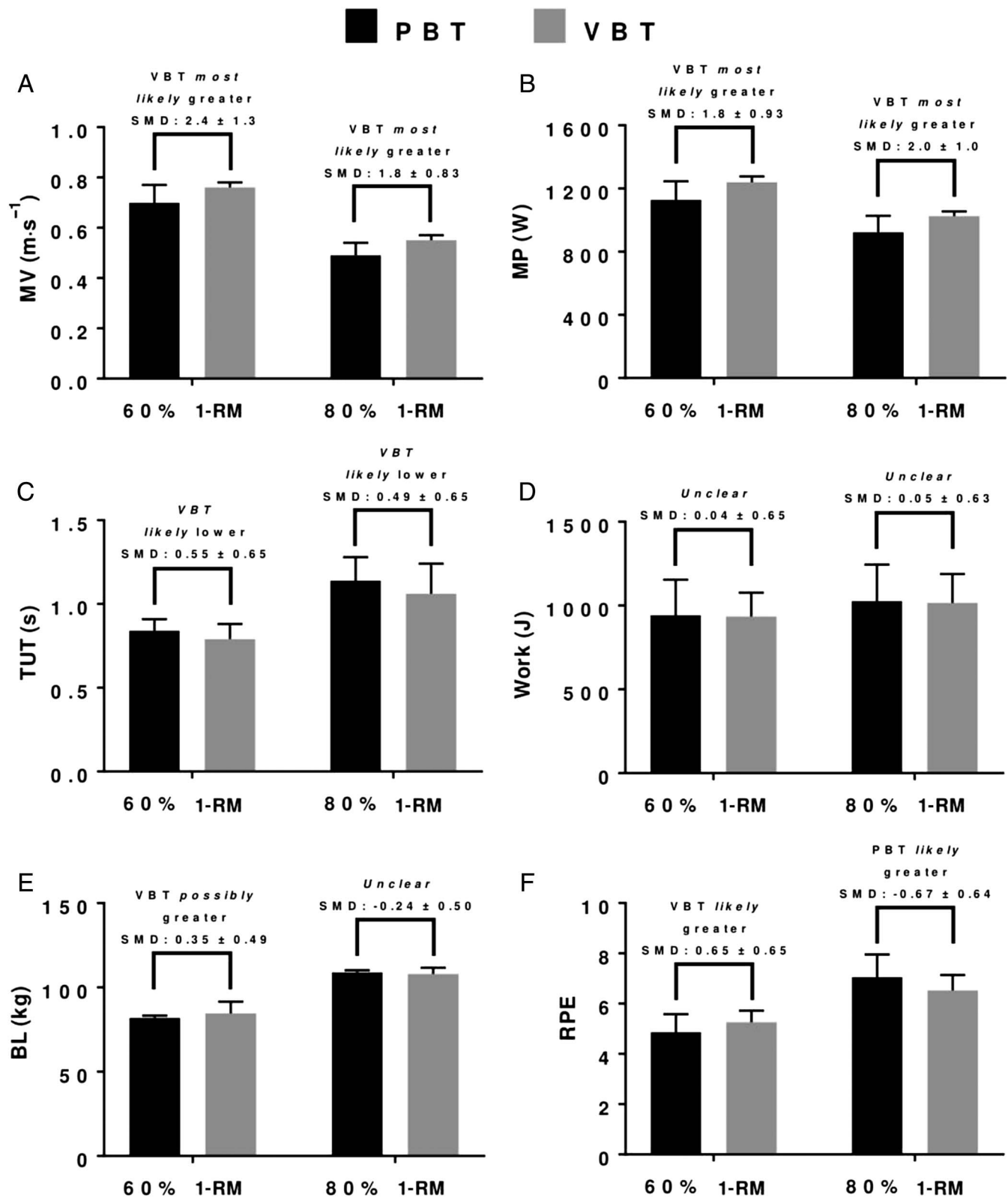


Figure 2 — Sessional MV (A), MP (B), TUT (C), work (D), BL (E), and RPE (F) at 60% and 80% of 1-RM in PBT and VBT groups. Data are presented as mean (SD) (TUT, work, and RPE) or adjusted mean (SEE) (MV, MP, and BL), along with SMDs and the corresponding 90% confidence interval. 1-RM indicates 1-repetition maximum; BL, barbell load; MP, mean power; MV, mean velocity; PBT, percentage-based training; RPE, rating of perceived exertion; SEE, standard error of the estimate; SMD, standardized mean difference; TUT, time under tension; VBT, velocity-based training.

lifting 60% 1-RM than 80% 1-RM, which led to barbell load being increased across the mesocycle. This is supported by the finding that adaptations in the load–velocity relationship induced by VBT were specific to 60% 1-RM. Consequently, using VBT methods at 60% 1-RM may lead to greater loads and RPE compared with PBT, while VBT at 80% 1-RM appears to maintain barbell load but reduce RPE.

There are some limitations to this study. Training load was only manipulated in the back squat; however, this aligns with previous VBT articles,^{25,26} and using velocity thresholds to adjust load in other lower-body exercises included in the training routine (Nordic lowers/unilateral Romanian deadlift) was not appropriate because maximizing concentric velocity is not the main training

objective for these exercises. Another limitation is that training load was not adjusted in the PBT group, whereas the VBT group continually modified load. Furthermore, although participants were randomized and completed the same training regimen, it cannot be guaranteed that on-field player loads were the same between groups, which could have influenced training adaptations. Finally, the magnitudes of effects were interpreted in relation to the SWC (baseline $SD \times 0.2$). Although this distribution-based statistic is widely used throughout the literature, it does not consider whether the magnitude of effect is important for rugby league performance.

Practical Applications

This study suggests that adjusting resistance-training load based on individual velocity thresholds is a superior alternative to conventional percentage-based approaches during the competitive rugby league season. VBT promoted faster back squat repetition velocities, minimized mechanical stress, and improved lower-limb explosive strength. However, it should be considered that VBT requires the use of relatively expensive devices, additional time to set up equipment and potentially more staff to competently monitor sessional velocity. Coaching staff must judge whether the benefits of VBT outweigh the increased financial and time burden compared with PBT.

Conclusions

Velocity-based training was associated with greater sessional velocity and power, as well as lower TUT and perceived training stress, throughout a 7-week mesocycle compared with PBT. VBT also led to a greater improvement in back squat velocity attained against 60% 1-RM compared with PBT. Therefore, this study is the first to show that VBT can be implemented during the competitive rugby league season, instead of traditional PBT, to improve lower-body training stimuli, decrease unnecessary training stress, and promote velocity-specific adaptations.

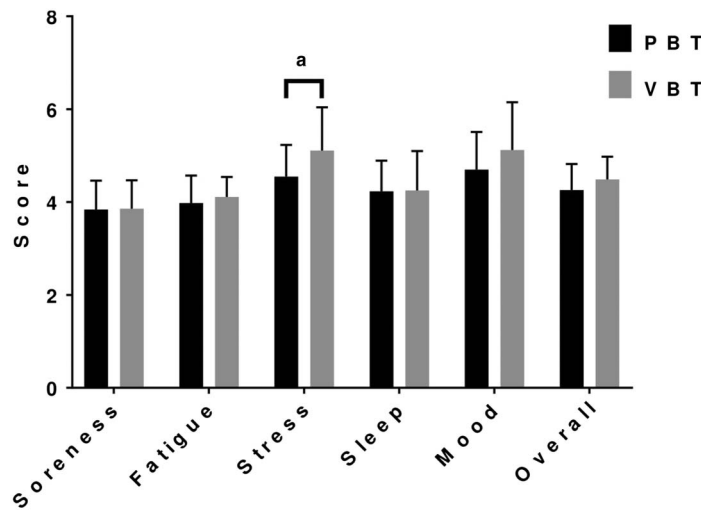


Figure 3 — Mean perceived wellness scores in PBT and VBT groups. PBT indicates percentage-based training; VBT, velocity-based training. ^a VBT had a likely beneficial effect on perceived stress (standardized mean difference = 0.66 ± 0.66). All other differences between groups were unclear. Data are presented as mean (SD).

Table 3 Mean (SD) at Preintervention and Postintervention, Within-Group Change Scores in Standardized Units (Δ SMD $\pm$ 90% CI), and Qualitative Inferences

	PBT (n = 15)				VBT (n = 12)			
	Pre	Post	Δ SMD	Inference	Pre	Post	Δ SMD	Inference
Squat 1-RM, kg	136 (16.6)	145 (16.8)	0.51 ± 0.15	Most likely $\uparrow$	137 (18.5)	145 (16.6)	0.38 ± 0.12	Very likely $\uparrow$
CMJ, cm	38.0 (3.9)	39.6 (4.3)	0.40 ± 0.53	Possibly $\uparrow$	39.2 (4.3)	41.7 (5.5)	0.53 ± 0.37	Likely $\uparrow$
RSI, m/s	1.16 (0.18)	1.28 (0.20)	0.53 ± 0.47	Likely $\uparrow$	1.34 (0.36)	1.35 (0.31)	0.01 ± 0.28	Unclear
Sprint time, s								
5 m	1.03 (0.07)	1.07 (0.09)	-0.69 ± 0.71	Likely $\downarrow$	1.09 (0.08)	1.10 (0.08)	-0.09 ± 0.79	Unclear
10 m	1.77 (0.05)	1.81 (0.09)	-0.81 ± 0.81	Likely $\downarrow$	1.74 (0.21)	1.84 (0.08)	-0.41 ± 0.51	Likely $\downarrow$
20 m	3.01 (3.10)	3.10 (0.11)	-1.02 ± 0.47	Very likely $\downarrow$	3.09 (0.08)	3.13 (0.13)	-0.48 ± 0.79	Unclear
30 m	4.19 (0.12)	4.29 (0.15)	-0.78 ± 0.39	Very likely $\downarrow$	4.27 (0.12)	4.36 (0.19)	-0.70 ± 0.66	Likely $\downarrow$
LVP, m/s								
40%	1.00 (0.06)	1.00 (0.10)	0.00 ± 0.67	Unclear	0.95 (0.10)	0.99 (0.08)	0.38 ± 0.46	Likely $\uparrow$
60%	0.82 (0.06)	0.81 (0.10)	-0.13 ± 0.63	Unclear	0.78 (0.10)	0.82 (0.08)	0.47 ± 0.37	Likely $\uparrow$
80%	0.61 (0.07)	0.63 (0.07)	0.22 ± 0.42	Possibly $\uparrow$	0.58 (0.08)	0.61 (0.08)	0.38 ± 0.60	Unclear
90%	0.49 (0.06)	0.51 (0.08)	0.38 ± 0.63	Unclear	0.46 (0.09)	0.49 (0.10)	0.32 ± 0.52	Possibly $\uparrow$

Abbreviations: $\uparrow$, increase; $\downarrow$, decrease; 1-RM, 1-repetition maximum; CI, confidence interval; CMJ, countermovement jump; LVP, load–velocity profile; PBT, percentage-based training; RSI, reactive strength index; SMD, standardized mean difference; VBT, velocity-based training.

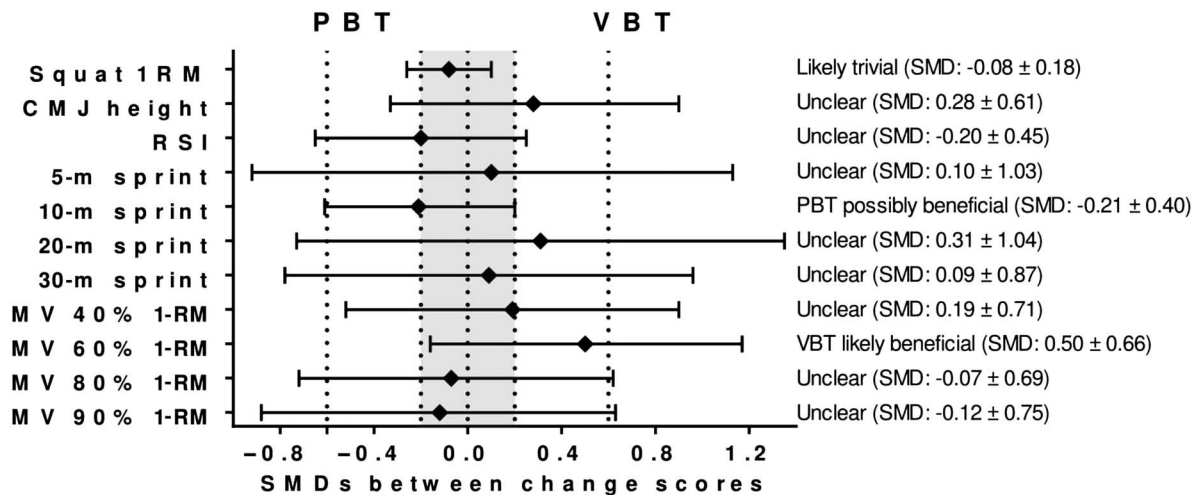


Figure 4 — SMDs between change scores and their corresponding 90% confidence intervals. Area shaded in gray represents a trivial SMD. 1-RM indicates 1-repetition maximum; CMJ, countermovement jump; MV, mean velocity; PBT, percentage-based training; RSI, reactive strength index; SMD, standardized mean difference; VBT, velocity-based training.

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