COMPARISON OF VELOCITY-BASED & TRADITIONAL RESISTANCE EXERCISE TRAINING

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This study compared the effects of 4 weeks (8 training sessions) of velocity-based resistance exercise (RE) training (VBT) and Traditional RE training (Trad) on maximal muscular strength (1-RM), total load (TL), total RE time (TT) and rating of perceived exertion (RPE) across days of training. Thirty-eight individuals (20 females & 18 males) were randomly assigned to VBT or Trad for 1 leg-leg extension RE training study. The VBT completed 3 sets of reps until velocity decreased by 20%; Trad completed 3 sets of 12 repetitions or until failure. TL, TT and RPE were significantly lower across days of training for VBT, while 1-RM increased significantly and similarly for both groups and males and females. These data suggest VBT provokes a similar increase in muscular strength with less TL (work), TT and effort (RPE) during a short-term training study.

KEYWORDS: Training-study, single-leg leg extension, movement-velocity

INTRODUCTION: Velocity-based resistance (RE) training (VBT) is a new concept that has been shown to improve sport performance by using monitoring technology to measure movement velocity, which enables training loads to be adjusted individually in real-time. The objective is to detect acute muscular fatigue so that training loads can be adjusted on a set-by-set basis (Sanchez-Moreno, Rodriguez-Rosel, Pareja-Blanco, Mora-Custodio, & Gonzalez-Badillo, 2017). Recent research has shown that a decrease in movement velocity is indicative of acute muscular fatigue and that movement velocity has been shown to be a more important indicator of muscular strength adaptations than time under tension (Pareja-Blanco, Rodriguez, Sanchez-Medina, Gorostiaga, & Gonzalez-Badillo, 2014). This was shown when a high velocity-training group had similar squat strength gains, and a greater increase in vertical jump, when compared to a lower velocity based training group (Pareja-Blanco et al., 2017). The purpose of this study was to compare the effects of 4 weeks (8 training sessions) of VBT and Trad RE training on muscular strength (1-RM) in young-adult females (20) and males (18), as little research has been published comparing traditional methods of RE training against VBT RE training. A secondary purpose was to examine the relationship between total RE time (TT), total load (TL) and average RPE across 8 days of training with respect to changes in muscular strength.

METHODS: Twenty females and 18 males were randomly assigned to VBT or Trad groups. Each group consisted of 10 females and 9 males. On day 1, a series of anthropometric measures were taken, as shown in Table 1.

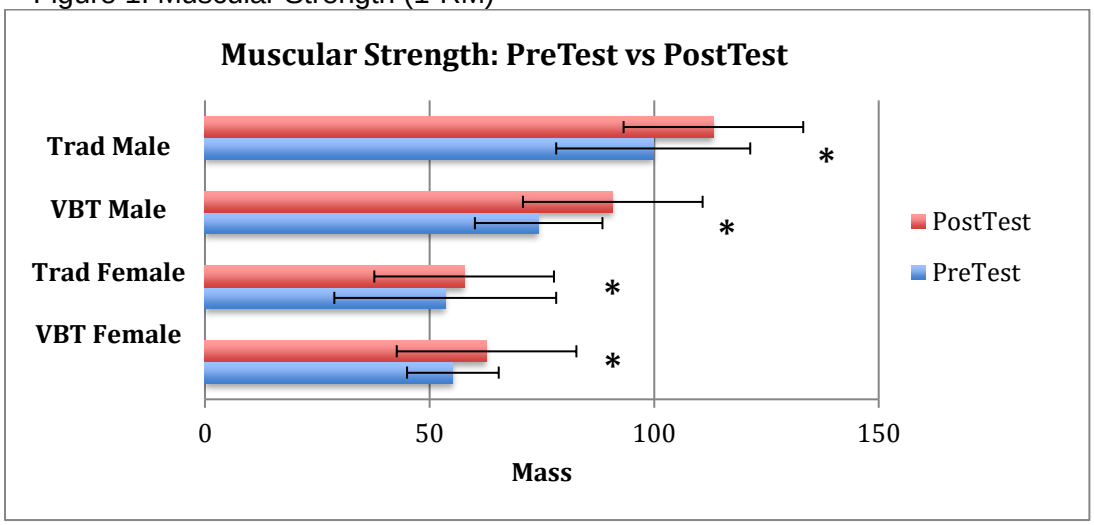
Table 1. Physical Characteristics; Values are expressed as Mean (S.D.)

Variable	VBT Female	VBT Male	Trad Female	Trad Male
Age (years)	21.0(0.6)	21.1(1.1)	21.0(0.9)	21.3(1.0)
Mass (kg)	67.6(6.4)	78.5(5.5)	62.6(9.0)	90.1(4.9)
Height (cm)	163.9(9.2)	179.6(5.4)	164.9(9.0)	186.0(2.3)
BMI	25.3(3.1)	24.4(1.7)	23.9(1.3)	25.9(1.1)
R Leg Length (cm)	85.1(5.6)	93.3(4.3)	85.9(6.7)	97.1(4.6)
R Lower Leg Length (cm)	34.5(3.7)	37.8(6.1)	35.5(3.6)	37.5(1.5)
R Thigh circumference (cm)	50.2(2.7)	49.9(3.3)	48.8(3.1)	51.1(5.2)

After anthropometric measures were taken, 1-RM tests of 1-leg leg extension for the right and left legs were recorded. The 1-RM was determined by progressively adding weight until the subject could no longer complete a full repetition. On day 2, 48 hours after day 1,1-RM re-tests were performed to determine the reliability of day 1, 1-RM testing. Over the span of 4 weeks, both groups completed 8 training sessions (2 days per week) of 1-leg leg extension for their right leg only. Subjects reported for training sessions on Monday and Wednesday mornings at a consistent time each day. Each group and each individual worked at approximately 75% of 1-RM. VBT completed 3 sets of repetitions, until velocity decreased by 20% during each set for 2 consecutive repetitions. Movement velocity was monitored in real time with an ultrasound sensor, NI-cRIO hardware, and custom-built software (NI-LabView) was used to collect, analyze and store the data. Trad completed 3 sets of 12-15 repetitions, or until failure of a repetition occurred prior to reaching the 12th repetition. For both groups, to ensure progressive overload, resistance was increased by 2.5, 5.0 or 10 lbs if a subject was able to complete 12 repetitions for 2 sets. Following the completion of the RE training program, anthropometric measurements and 1-RM tests were repeated. This study used a pretest-posttest, within-subjects design; analysis of variance with repeated measures and a-priori contrasts were used to statistically analyze the data.

RESULTS: For both the males and females, as shown in Figure 1, 1-RM increased significantly following RE training ($p<0.001$). Both the Trad and VBT groups exhibited similar increases in 1-RM. There was no significant group or group by sex interactions.

Figure 1. Muscular Strength (1-RM)



*Denotes Significant PreTest – PostTest Main Effect; ($p<0.001$)

As shown in Figure 2, TT, across days of training for VBT was significantly less when compared to Trad ($p<0.05$), for both females and males. TL (repetitions X resistance load, summed over 8 RE training sessions) was significantly lower for VBT as compared to Trad ($p<0.05$), for both females and males, which is shown in Figure 3. As shown in Figure 4, RPE (averaged across each set and 8 RE training sessions) was significantly lower for VBT as compared to Trad ($p<0.05$), for both females and males.

Figure 2. Total RE Time across Days of Training

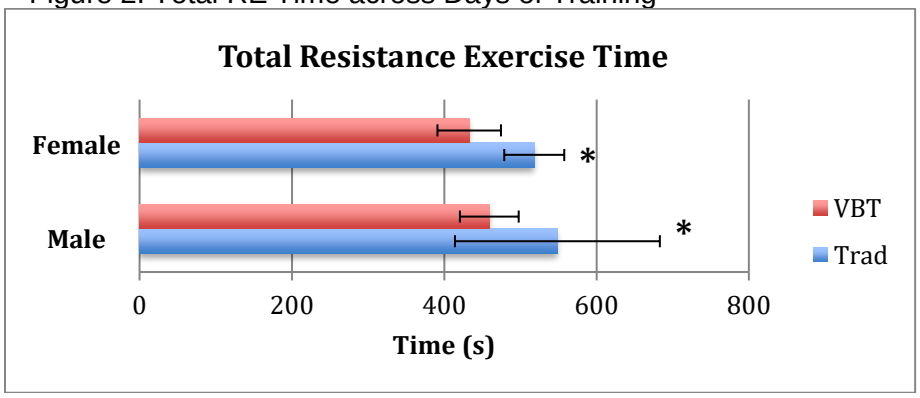


Figure 3. Total RE Load across Days of Training

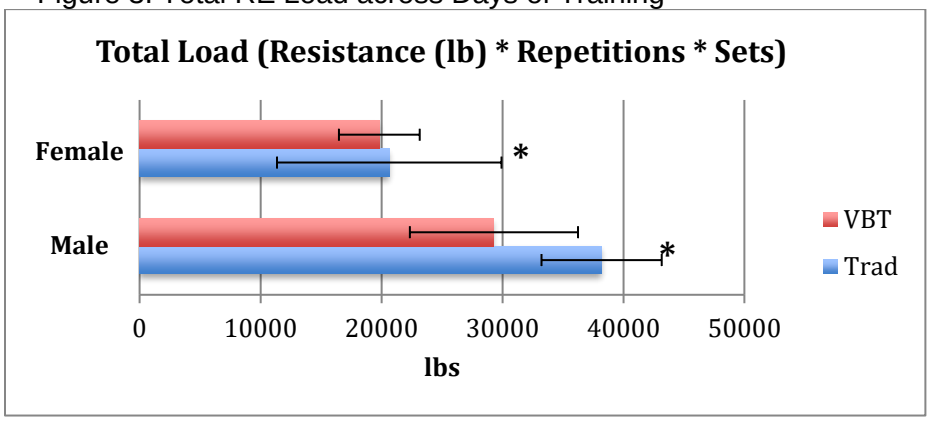
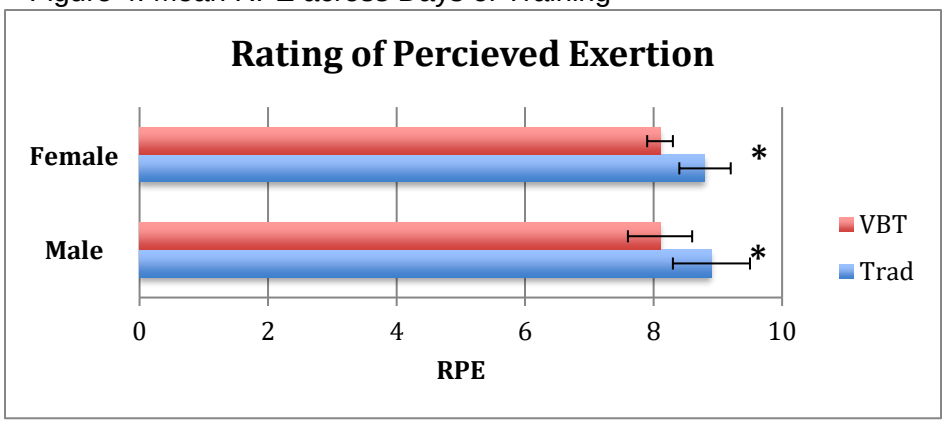


Figure 4. Mean RPE across Days of Training



*Denotes Significant Group Main Effects for Females & Males; ($p<0.05$)

DISCUSSION: During the 4 week RE training study, both VBT and Trad RE group exhibited a significant increase in 1-RM and males and females exhibited similar increases in 1-RM. This is important because the groups trained differently. The VBT group performed each repetition at maximum movement velocity; each set was stopped after an approximate 20% drop in velocity for a given repetition. The Trad group completed 12-15 reps for each set or until repetition failure was reached, without regard for movement velocity. These RE training methodology differences resulted in significantly longer TT, larger TL, and higher RPE – across days and weeks of RE training for the Trad group. These findings are similar to (Pareja-Blanco et al.,

2017); they found that during a squat RE exercise, the higher velocity training group exhibited similar squat strength gains, and a greater increase in vertical jump, as compared to a lower velocity training group. The high-velocity RE group completed 60% of the total volume that the low-velocity training group performed (Pareja-Blanco et al., 2017). In our study, the VBT group completed approximately 80% of the TL as compared to the Trad group.

Our RE training study was designed to be 4 weeks to insure the majority of the training adaptations resulted from neuromuscular-mediated factors (Kraemer & Spiering, 2007). Our results show that VBT can be used with males and females as there were no significant group-by-sex interactions; VBT groups of males and females exhibited similar results when compared to the Trad RE group. Additionally, previous work has shown women with an average age of 73 and men with an average age of 68 were found to exhibit a greater increase in peak power in the leg press when working at higher velocities, as compared to men and women RE training at lower velocities (Bottaro et al., 2006; Fielding et al., 2002). Our data suggest, this type of RE training can be used in many aspects of sport performance and also, potentially, for rehabilitation purposes. From a sport performance viewpoint, athletes and coaches can use this training style to optimize RE training to improve performance and minimize training loads and RE time. This is important with respect to risk of injury and overtraining. From a rehabilitation viewpoint, therapists and patients could expect to increase muscular strength with less exercise training time (TT), resistance load (TL) and perceived effort (RPE), especially during the initial phase of rehabilitation.

CONCLUSION: These data suggest that using VBT for short-term or at least at the start of a RE training program is viable and a more efficient RE training methodology. VBT results in similar muscular strength gains for women and men as compared to Trad RE training, at least during the initial 4 weeks of RE training. Additionally, the TL, TT and RPE for the VBT group was significantly less across 8 days of training when compared to the Trad group, yet the VBT group increased muscular strength similarly. This information can be used in multiple aspects of sports performance training and rehabilitation. Sports teams can use this type of RE training to improve performance with less time, load and perceived effort, thereby lessening the risk of overtraining and potential injury. Moreover, this type of RE training/rehabilitation experience may result in greater adherence and more favorable perceptions of initial rehabilitation/exercise training experiences.

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