A Novel Approach to Predicting 3RM Using Velocity-Based Measurement

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The purpose of this study was to identify the minimum mean concentric velocity necessary for the successful completion of repetitions in the back squat and bench press. Participants were 7 Division 1 Track and Field throwers, 5 females and 2 males, and performed 3RM testing at 90% of their 1RM in both the back squat and bench press, for which the mean concentric velocities of the bar was recorded. A strong negative correlation (r = -0.99) was determined between mean concentric velocity in the back squat (mean = 0.25 m/s) and the lowest mean concentric velocity for repetitions in the bench press was 0.12 m/s. [Conclusion] To potentially reduce the risk of injury and fatigue leading to overtraining, the strength and conditioning professional should be aware of the respective velocities necessary for the successful completion of repetitions in the back squat and bench press so as to avoid taking an athlete to absolute failure.

Traditionally, the strength and conditioning professional has relied upon prescribing training intensities based upon varying percentages of the one repetition maximum (1RM) with concurrent modifications to volume load and training frequency (1). However, such an approach is retrospective in nature in that it only provides quantification of a resistance training session after its conclusion and the information collected can only be used to modify a subsequent session (2). In contrast, velocity-based training is a method that allows coaches and practitioners to determine and assign optimal training loads based on how fast the athlete moves a load at which the load is moved on a given day at a specific time independent of 1RM (1). Specifically, the use of VBT (velocity-based training) is in that it accommodates for differences in training status due to daily variability and thus enables training to be tailored accordingly (3,4).

Consequently, VBT provides the strength and conditioning professional with the ability to accommodate for periodic intervals of decreased performance by prescribing the minimum stimulus required to induce positive physiologic adaptation while simultaneously attempting to prevent nonfunctional overtraining during times of high social, academic, or physical stress (1). In regard to specificity of training, VBT attempts to identify the optimal velocities at which specific movements should be moved in order to optimize training. Adhering to such velocity parameters better ensures the engagement of the appropriate energy systems and training demands in order to maximize the development of power, strength, and anaerobic and aerobic greater sport performance (1). Such information is invaluable to the strength and conditioning coach to ensure that an athlete is developing the desired physiologic adaptations through appropriate training. Lastly, VBT provides immediate feedback that can influence motivation and thus improve performance (1). Provided with instantaneous quantitative data, the athlete will often endeavor to increase the velocity of each sequential repetition to best his or her previous performance (1). Such an effect is especially desirable towards the latter development of power, whereby the load moved is more significant in explaining improvements in functional performance (5,6,7).

The purpose of this study was to identify the minimum mean concentric velocity necessary for the successful completion of repetitions in either the back squat or bench press, by allowing athletes and practitioners to be able to predict whether an athlete will fail during the next subsequent repetition based upon the mean concentric velocity of the previous repetition. As a result, it would be unnecessary to allow athletes to absolute failure during either testing or training, thus reducing the risk injuries, improving testing procedures and may prevent excessive fatigue leading to overtraining.

Statistical Analysis
All mean and standard deviation values for both repetitions in the back squat and bench press were calculated using Microsoft Excel version (14.1) (IBM, USA). Furthermore, the Pearson product-moment correlation coefficient (r) was used to evaluate the relationship between mean concentric velocity of repetitions in the back squat and bench press and %1RM.

As anticipated, a negative correlation was observed between mean concentric velocity of repetitions and intensity (%1RM) in both the back squat and bench press. Specifically, as loading increased, a simultaneous decrease in the mean concentric velocity of repetitions was observed. The strength and direction of this linear relationship was evaluated using the Pearson product-moment correlation coefficient (r). For repetitions in the back squat, a correlation coefficient of r = -0.99 was determined, indicating a strong negative relationship. For repetitions in the bench press, a value of r = -0.97 was calculated, suggesting a similarly strong negative relationship. See Figure 1 and Figure 2 below for illustration.

The noted disparity between 100% 1RM velocities in the back squat and bench press testing was attributed to the inherent nature of the lifts and the movements associated with them. As a result, athletes and practitioners should be aware of the anticipated and therefore did not represent a true measurement of their 3RM ability.

CONCLUSION
According to the results obtained from this study, a minimum mean concentric velocity of 0.25 m/s is required for repetitions in the back squat whereas a minimum mean concentric velocity of 0.12 m/s is required for repetitions in the bench press. Taking into consideration individual variation due to training age, the coach or practitioner should be alert for velocities approaching the aforementioned values when testing or training using a velocity-based approach. Specifically, by noting when an athlete is moving below the aforementioned minimum velocity values, it becomes possible to predict the approximate repetition at which absolute muscular failure will occur. As a result, by avoiding taking an athlete to absolute failure, the risk of injury and fatigue leading to overtraining may potentially be reduced.

REFERENCES