Technical Note on Using the Movement Velocity to Estimate the Relative Load in Resistance Exercises – Letter to the Editor

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ABSTRACT

The studies by Sanchez-Medina et al. (Sports Medicine International Open, 1(02), E80-E88. 2017) and Gonzalez-Badillo and Sanchez-Medina (Int J Sports Med, 31, 347–52. 2010) attempted to provide a good estimation of relative load from movement velocity measured in bench press and full squat. However, both aforementioned studies contain methodological issues concerning the predicted equations used to address load-velocity relationship that coaches should be aware of.

Dear Editor,

We read with great interest the studies by Sanchez-Medina et al. [8] and Gonzalez-Badillo and Sanchez-Medina [3] whose main aim was to provide an estimation of the relative load from the movement velocity measured in bench press and in full squat. Unfortunately, the analyses used are not correct and, in our view, could show an overestimation of the relative load; consequently, this may not be useful for coaches.

The recent increase in the use of devices such as accelerometers, velocity transducers, or cameras capable of calculating velocity during resistance exercises, allows estimating the 1RM and the relative training loads from the relationship between movement velocity and relative load (%1RM). Several studies have reported suitable equations for estimating relative load from velocity measurements [1, 3–6, 8]. Two studies have proposed very close relationships ($R^2 > 0.94$) between both mean accelerative velocity (calculated from the accelerative portion of the concentric phase, during which the acceleration of the barbell was $\geq -9.81\ m \cdot s^{-2}$) and mean velocity with the %1RM used during bench press [3] and full squat [8] performed on smith machine. Even though the aforementioned investigations offer practical and useful information for helping coaches at controlling resistance training, there are several issues that deserve our attention. In both cases, authors used a second-order polynomial relationship between the relative load (%1RM) and mean or accelerative velocity measured over the concentric phase. For the bench press exercise, authors included more than one load-velocity assessment per participant. This statistical process may have overestimated the data fit due to the presence of autocorrelation. Autocorrelation occurs when the residuals are not independent from each other. When more than one observation from the same participant is used to calculate the load-velocity relationship, the observations can no longer be independent and the resulting R^2 will be inflated [2, 7].

Although for the full squat study the authors selected only one repetition per set based on the fastest accelerative velocity, the calculated coefficient of determination assessing the relationship between load (%1RM) and velocity using second-order polynomials would still overestimate the data fit. When performing multiple measures, in order to control the effect of the previous set/repetitions during the progressive test, data should be adjusted performing a longitudinal regression analysis. Thus, with the aim of preventing calculation bias and making results comparable to similar studies [1, 4–6] we encourage authors to use a longitudinal regression analysis of the assessments.

Additionally, it is important to highlight that when bench press and full squat have been performed in a smith machine, the resulting equations should be limited to this particular setting. The equations are not applicable to the same exercises using free weights that athletes typically use.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Key words

load-velocity relationship, %1 RM, longitudinal regression analysis

Bibliography

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