THE EFFECT OF DIFFERENT TRAINING VOLUMES ON ISOMETRIC AND DYNAMIC STRENGTH IN RESISTANCE-TRAINED INDIVIDUALS

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Background & Purpose

- The configuration of resistance training (RT) variables plays a critical role in driving skeletal muscle adaptations. Among these variables, RT volume is an essential determinant that quantifies the overall dose of training[1]. Furthermore, weekly set volume has gained traction, whereby meta-analytic evidence suggests multiple weekly sets being superior to single set protocols in trained cohorts[2].
- Recent meta-regression data[3] showcased a continuous relationship of different RT weekly 'fractional' set volumes on maximal strength outcomes. Findings suggests a clear early-on dose response relationship between maximal strength and RT weekly volume but exhibit strong diminishing returns beyond approximately four sets per week.
- A key limitation in the RT volume literature is the lack of practical applicability due to scarcity of individual level data. Several key physiological factors can alter the adaptive response to RT from a given dosage of volume. Thus, requiring further investigations using diverse volume configurations from varying cohorts. Additionally, the impact of long-term RT weekly volume on multiple measures of strength remains equivocal and requires further investigation.
- The purpose of this investigation was to compare the effects of two weekly resistance training volumes on lower body dynamic and maximal voluntary isometric contraction strength adaptations in trained individuals over the course of 8 weeks.

References

1. Baz-Valle, Eneko1; Fontes-Villalba, Maelán2; Santos-Concejero, Jordan1. Total Number of Sets as a Training Volume Quantification Method for Muscle Hypertrophy: A Systematic Review. Journal of Strength and Conditioning Research 35(3):p 870-878, March 2021. | DOI: 10.1519/JSC.0000000000002776
2. Ralston, G. W., Kilgore, L., Wyatt, F. B., & Baker, J. S. (2017). The Effect of Weekly Set Volume on Strength Gain: A Meta-Analysis. *Sports medicine (Auckland, N.Z.)*, *47*(12), 2585–2601. https://doi.org/10.1007/s40279-017-0762-7
3. Robinson ZP, Pelland JC, Remmert JF, Refalo MC, Jukic I, Steele J, Zourdos MC. Exploring the Dose-Response Relationship Between Estimated Resistance Training Proximity to Failure, Strength Gain, and Muscle Hypertrophy: A Series of Meta-Regressions. Sports Med. 2024 Sep;54(9):2209-2231. doi: 10.1007/s40279-024-02069-2. Epub 2024 Jul 6. PMID: 38970765.

Results

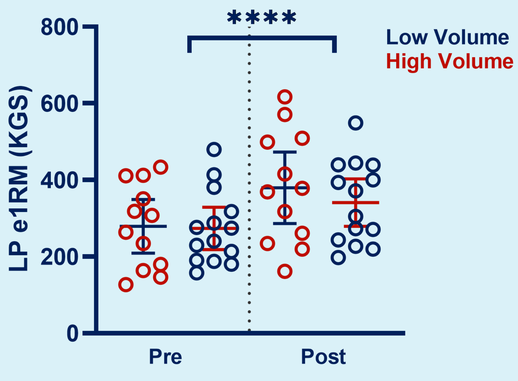

Figure 1. Individual subject plots and mean (±95% CIs) for MVIC strength for the low- and high-volume groups prior to (Pre) and following 8 weeks of resistance training.

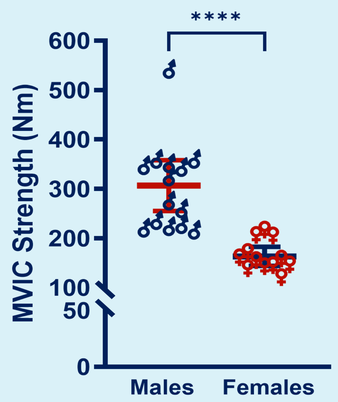

Figure 2. Individual subject plots and mean (±95% CIs) for MVIC strength between males and females when collapsed across time and group.

****Indicates significantly greater MVIC strength in males

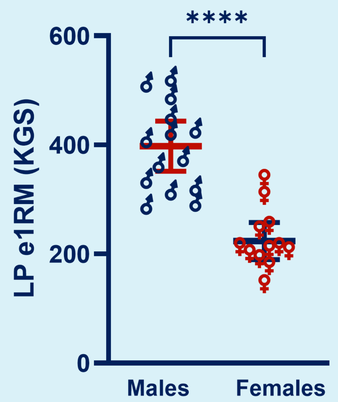

Figure 3. Individual subject plots and mean (±95% CIs) for leg press estimated 1RM (e1RM) for low- and high-volume groups prior to (Pre) and following 8 weeks (Post) of resistance training.

****Indicates significantly greater e1RM leg press strength in males

There were no 3-way (p= 0.100-0.916) or 2-way (p= 0.092-0.575) interaction effects for MVIC strength or LP e1RM. For MVIC strength, there was a main effect for sex (p<0.001), by which males exhibited significantly greater MVIC strength than females when collapsed across time and group (M: 315.8 ± 100.4 Nm vs. F: 163.2 ± 31.5 Nm; p<0.001). For LP e1RM, there were significant main effects for both sex and time (p<0.001 for both). Post-hoc analyses indicated that when collapsed across time and group, males exhibited greater LP e1RM than females (M: 395.5 ± 82.6 kg; F: 223.8 ± 53.8 kg). When collapsed across sex and group, LP e1RM significantly increased from PRE (270.5 ± 98.3 kg) to POST (355.6 ± 127.5 kg).

Methods

25 resistance-trained individuals (12 F/13 M) participated in this 8-week progressive RT intervention. Participants were randomized into two RT groups: high volume (HV; F/M: 7/6) or low volume (LV; F/M: 6/6). Subjects completed 2 lower body training sessions each week for 8 weeks performing the leg press (LP) exercise during each session with different training volumes based on their group allocation. Subjects in the HV completed 4 sets per session, while the LV group completed 2 sets of LP per session. The initial training session consisted of 65% of the participants' LP e1RM. To progress the load each session, the final set on the LP exercise was taken to concentric muscular failure, whereby subsequent sessions were progressed in load based on autoregulatory progressive resistance exercise (APRE). Before (PRE) and following (POST) the RT intervention, estimated LP 1RM (LP e1RM), which was estimated using a 3-5RM testing protocol, and maximal voluntary isometric contraction (MVIC) strength of the subject's dominant knee extensors at 90 degrees of knee flexion were measured. Separate group (HV/LV) × sex (M/F) × time (PRE/POST) repeated measures ANOVAs were used to examine each dependent variable. Post-hoc tests were conducted to examine significant effects and the alpha level was set a-priori at 0.05.

Conclusions

Based on the present data, LP e1RM may be more sensitive to changes in maximal strength than knee extension MVIC. Importantly, this increase in LP e1RM was independent of training volume, suggesting that there may be more important factors than training volume contributing to maximal strength adaptations. Moreover, maximal isometric strength did not increase significantly over time showcasing the principle of specificity and sensitivity of strength as an adaptive skill.

Practical Applications

Strength coaches and/or trainees must implement training phases aimed at specifically loading isometric knee extensions to see improvements in strength over time. Furthermore, the data suggests that 8 sets per week of lower body training may be effective enough to stimulate strength gains in well trained trainees if the principle of specificity is maintained.