

# THE EFFECTS OF SET STRUCTURE ON RECTUS FEMORIS AND VASTUS LATERALIS ADAPTATIONS IN TRAINED INDIVIDUALS

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## BACKGROUND & PURPOSE

Resistance training (RT) is widely recognized for its role in stimulating skeletal muscle hypertrophy through mechanical tension and neuromuscular adaptations. However, manipulating set structure such as using traditional sets (TR) versus cluster sets (CL) may influence performance and muscular responses. Cluster sets, which incorporate short intra-set rest periods, have been shown to reduce fatigue and better maintain power output throughout a session compared to traditional sets<sup>1</sup>.

Quadriceps muscles like the rectus femoris (RF) and vastus lateralis (VL) often show distinct responses to training based on fiber composition and function. Additionally, sex-based differences in training outcomes have been reported. While males typically gain more absolute muscle mass, relative hypertrophic responses between sexes may be comparable when training volume is matched<sup>2</sup>. These findings highlight the need to examine how set structure and sex interact to influence muscle-specific adaptations. The aim of this study was to compare the effects of TR and CL set structures on RF and VL muscle thickness in trained males and females following a 4-week resistance training protocol.

## METHODS

Seventeen resistance-trained individuals (9 males, 8 females; age range: 18-33 years) completed this 4-week resistance training intervention. Participants underwent 8 (2x/week) supervised lower-body resistance training sessions, each separated by at least 48 hours. A within-subject design was used, with each participant's legs randomized to one of two conditions:

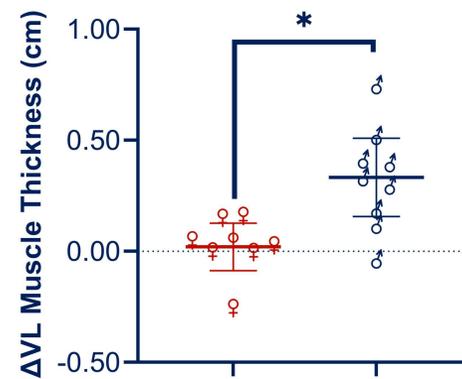
- **Traditional (TR):** 4 sets performed to volitional failure
- **Cluster (CL):** 4 sets equated to TR for total workload and duration, but divided into mini-clusters with intra-set rest

Muscle thickness of the RF and VL was assessed at baseline (PRE) and post-intervention (POST) via ultrasonography. Separate three-way (condition × time × sex) repeated-measures ANOVAs were used to analyze differences in RF and VL muscle thickness, with post-hoc comparisons performed for significant interactions and/or main effects.

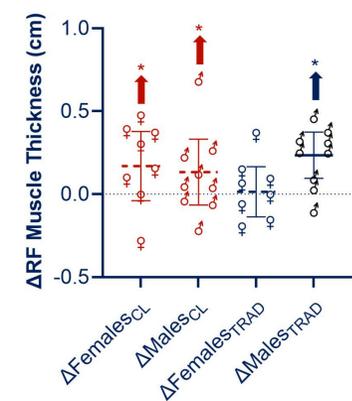
## REFERENCES

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## RESULTS



**Figure 1.** Mean ± 95% CIs for the change in vastus lateralis muscle thickness in males and females when collapsed across condition. \*Indicates significantly greater increase in males ( $p < 0.05$ )



**Figure 2.** Mean ± 95% CIs for the change in rectus femoris muscle thickness in males and females in the cluster (CL) and traditional (TRAD) set configurations. \*Indicates significant increase within group ( $p < 0.05$ )

A significant condition × time × sex interaction was observed for RF thickness ( $p = 0.020$ ). Post-hoc analyses indicated that in the CL group, RF muscle thickness significantly increased in both males (PRE:  $2.06 \pm 0.42$  cm; POST:  $2.19 \pm 0.26$  cm;  $p = 0.004$ ) and females (PRE:  $1.93 \pm 0.37$ ; POST:  $2.10 \pm 0.22$  cm;  $p = 0.024$ ). However, in the TR leg, RF muscle thickness only increased in males (PRE:  $2.10 \pm 0.34$  cm; POST:  $2.33 \pm 0.28$  cm;  $p < 0.001$ ) but not females (PRE:  $1.98 \pm 0.34$  cm; POST:  $1.99 \pm 0.28$  cm;  $p = 0.961$ ). There were no significant differences in RF muscle thickness between TR and CL legs within each sex at any timepoint ( $p = 0.067-0.463$ ). There was no significant 3-way interaction effect for VL muscle thickness ( $p = 0.889$ ); however, there was a significant time × sex interaction effect ( $p < 0.001$ ). Post-hoc analyses indicated that when collapsed across condition, VL muscle thickness significantly increased in males (PRE:  $1.94 \pm 0.52$  cm; POST:  $2.28 \pm 0.34$  cm;  $p < 0.001$ ), but not in females (PRE:  $2.10 \pm 0.34$  cm; POST:  $2.12 \pm 0.271$  cm;  $p = 0.263$ ).

## CONCLUSIONS

These findings suggest that both traditional (TR) and cluster (CL) resistance training elicited increases in RF and VL muscle thickness in males. In females, however, only the RF in the CL exhibited significant increases in muscle thickness, with no changes in the VL or RF of the TR leg. Thus, the present data suggests that both muscle and set structure may influence the hypertrophic responses, particularly in females.

## PRACTICAL APPLICATIONS

- **Set structure matters:** Cluster sets may offer hypertrophic advantages over traditional sets, particularly for the rectus femoris in female trainees.
- **Sex-specific programming:** Resistance training protocols may need to be adjusted based on sex, as females responded differently depending on set structure and muscle group.
- **Muscle-specific adaptation:** The rectus femoris and vastus lateralis exhibited distinct responses, reinforcing the importance of tailoring programming to specific muscle targets.
- **Recovery considerations:** The intra-set rest in cluster sets may enhance recovery and reduce fatigue during training, contributing to more favorable adaptations.
- **Program design insight:** Coaches and practitioners should consider incorporating cluster sets, especially when working with female clients or when addressing lagging muscle groups.