

# Effects of Handload on Muscle Coordination During Shoulder Flexion

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## INTRODUCTION

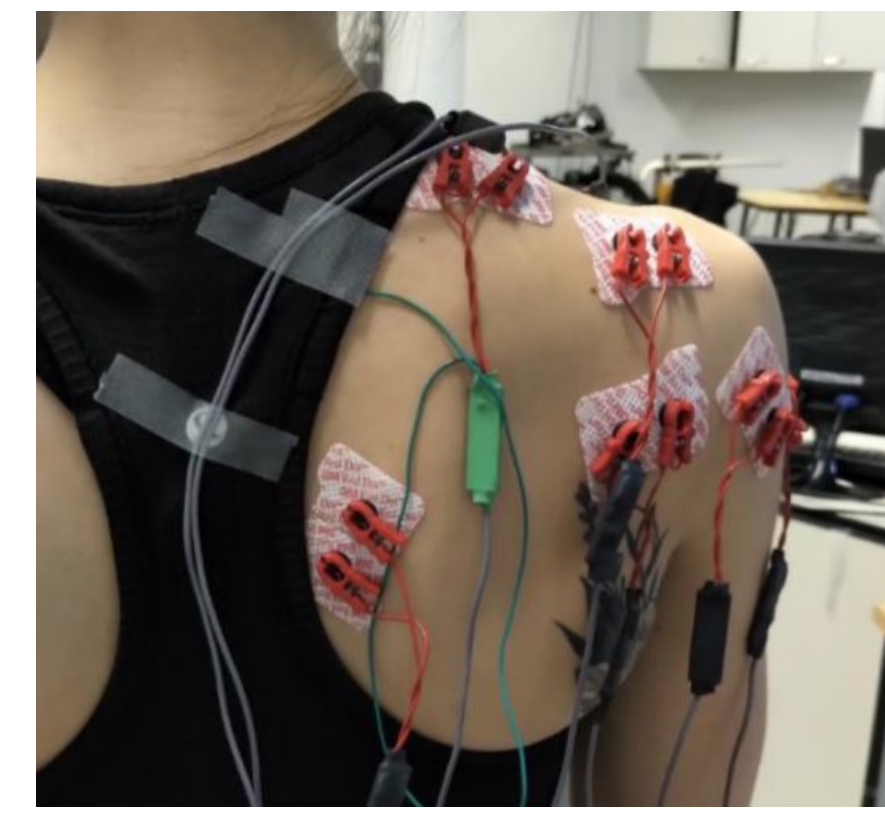
- Muscle coordination is important at the shoulder
- Supra/infraspinatus muscles are important in flexion <sup>[1]</sup>
- Deltoid helps with flexion when degrees increases <sup>[2]</sup>
- External rotator muscle fatigue, such as infraspinatus, has similar characteristics to injured shoulders <sup>[3]</sup>
- Limited research on the effect of varying hand loads

## METHODS

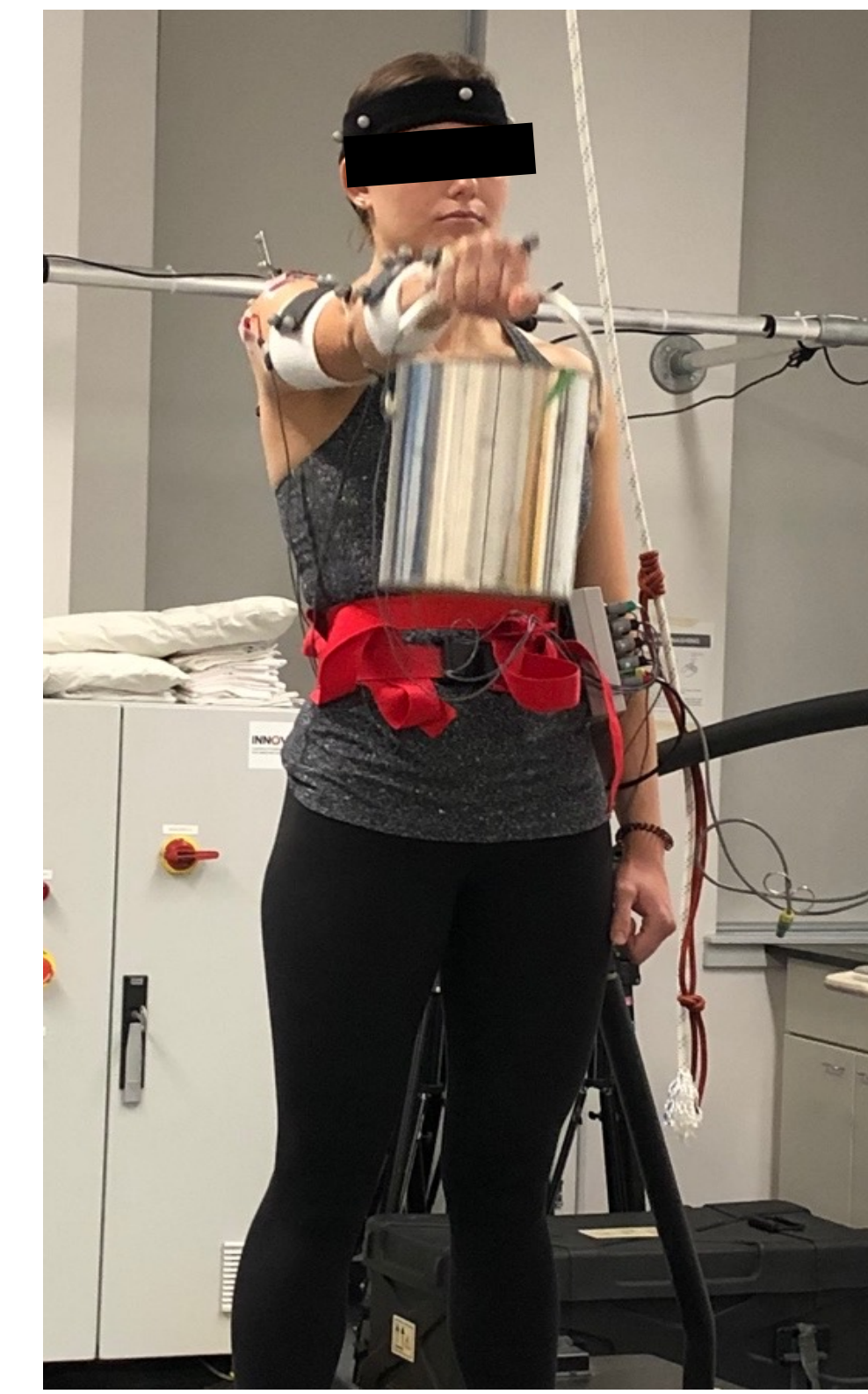
- Participants: Three healthy, older adults
- Task: Shoulder flexion with and without hand load (Figure 2)
- Electromyography to monitor muscle activation (Figure 1)
- Muscles of interest:
  - Infraspinatus, supraspinatus, trapezius (upper/lower), deltoid (anterior/middle/posterior), & pectoralis major
- Outcome: Average muscle activation during shoulder flexion

## PURPOSE

**Examine shoulder muscle coordination during shoulder flexion with different hand loads.**



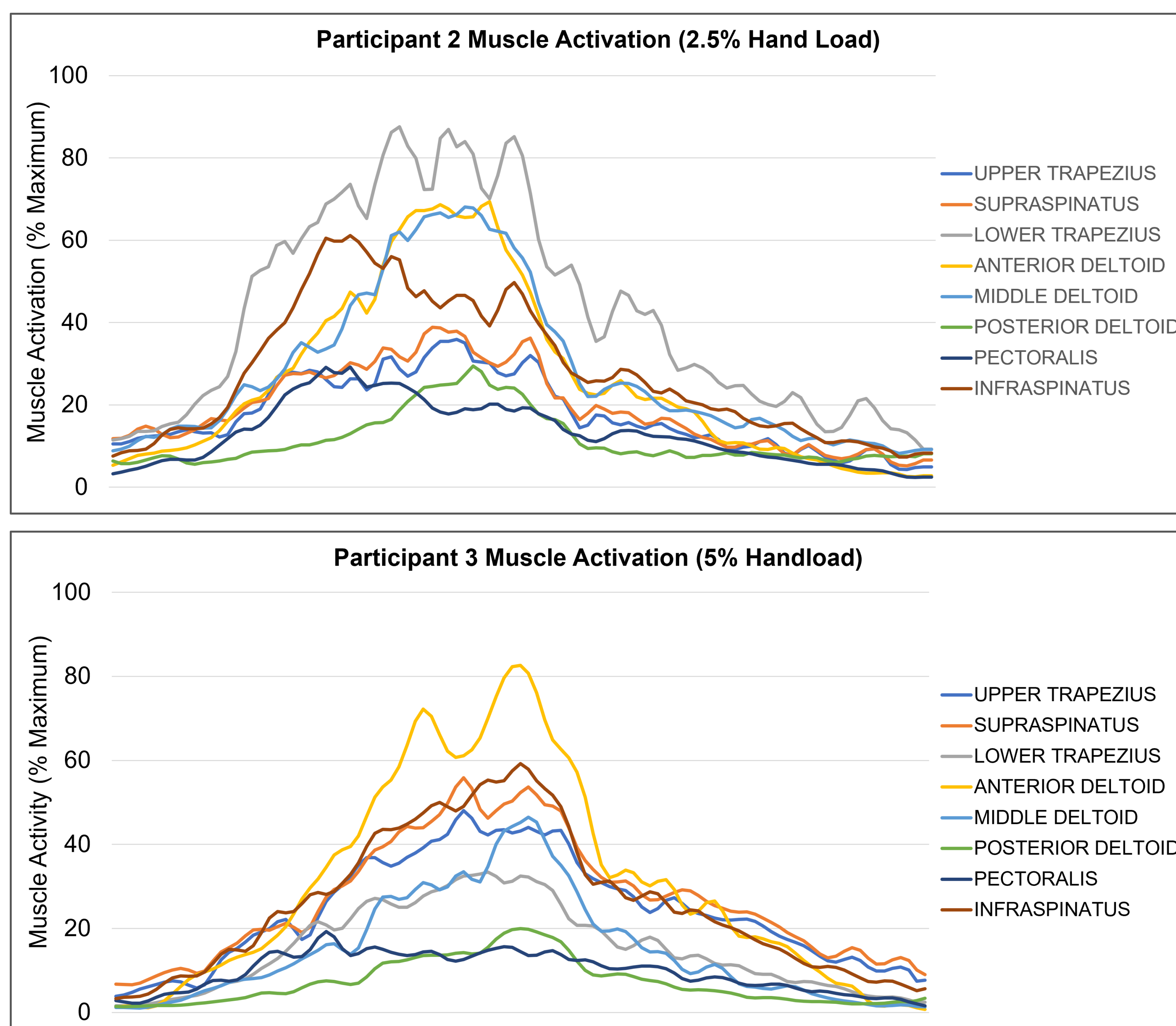
**Figure 1:** Posterior (top) and anterior/lateral (bottom) electrode placements



**Figure 2:** Participant completing 90-degree flexion task with hand load (left) and participant completing maximum flexion task without hand load (right).

## RESULTS

- Muscle activation varies from person to person (Figure 3)

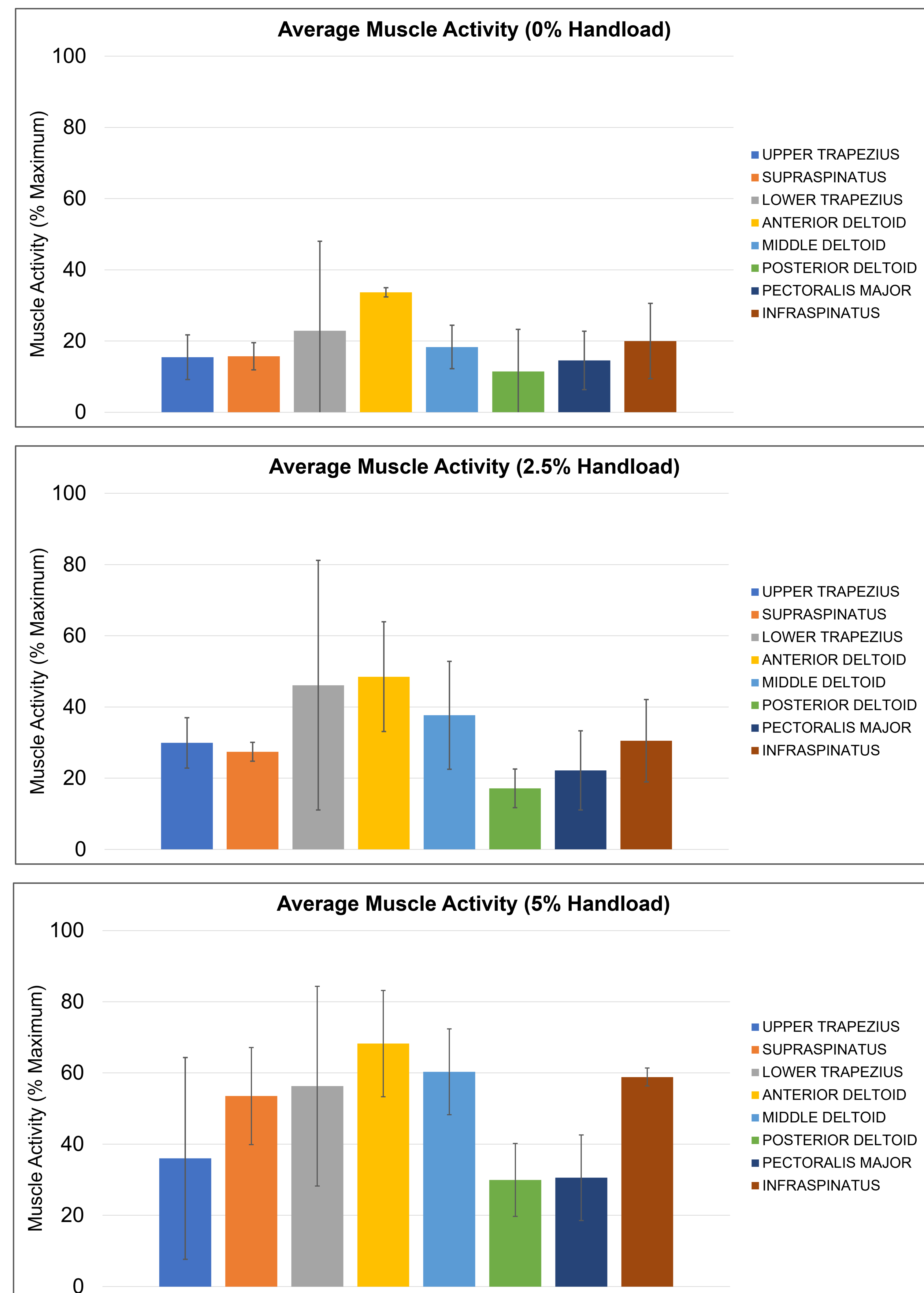


**Figure 3:** Muscle activation over the entire shoulder flexion task for 5% hand load trials in participants 2 & 3.

## DISCUSSION

- Insight into muscle coordination changes as hand loads increase
- The anterior/middle deltoid & lower trapezius appear most active in all trials.
- The remaining muscles gradually increase as the hand load increases, especially supraspinatus and infraspinatus.
- Differences in muscle activation show an increase in supporting muscle contribution to the flexion tasks which also increases with the hand load

- Anterior deltoid, middle deltoid & lower trapezius have highest activation for all hand loads (Figure 4)



**Figure 4:** Average muscle activation for all eight muscles, with standard deviation

### REFERENCES

- [1] Veeger, H. E. J., & van der Helm, F. C. T. (2007). *J Biomech.* 40(10), 2119-2129.
- [2] Hecker et al. (2021). *J Shoulder & Elbow.* 30(2).
- [3] Chopp & Dickerson. (2015). *Phys Therapy Review.* 20(3), 201-209.