Age Influences Muscle Excitation During The Five Times Sit-to-stand Clinical Test

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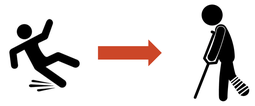
Functional Biomechanics Laboratory

Introduction

1 in 3 adults over 65 fall each year [1]

Falls lead to injury, reduced mobility and a lower quality of life



Five Times Sit-To-Stand test (5xSTS) is an evaluation muscle strength, balance and fall risk.

5 Times Sit-to-Stand

5xSTS time to completion, does not provide insight to movement strategy

Movement strategy differences across the lifespan could improve guidance of fall prevention

Are muscle coordination strategies different in older and younger adults during the 5 Times Sit-to-Stand?

Methods

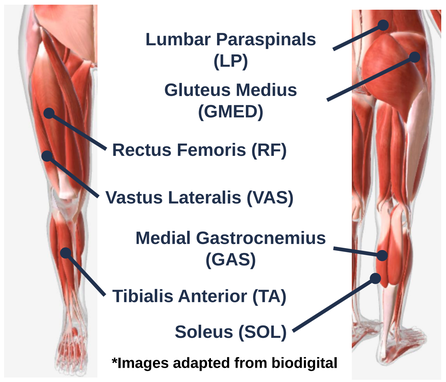
Participant Demographics

	Younger (n=11)	Older (n=11)
Age (years)	23.8 ± 5.0	62.1 ± 7.8
Height (in)	68.5 ± 2.3	66.9 ± 2.3
Weight (lb)	151 ± 47.8	178 ± 47.4
Sex	5F/6M	7F/4M

Participants active and healthy, no reported falls in the last year. *(±σ)

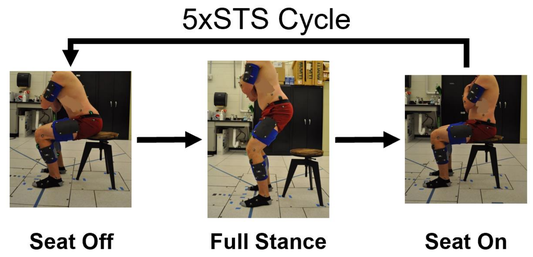
Experimental Data Collection

- Optical Motion Capture (Qualisys, f_s =200 Hz)
- In-Ground Force Plates (AMTI, f_s=2000 Hz)
- Electromyography (Delsys, f_s=2000 Hz)

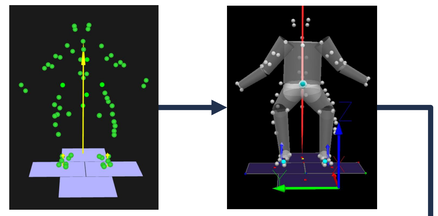


*Images adapted from biodigital

Data Processing

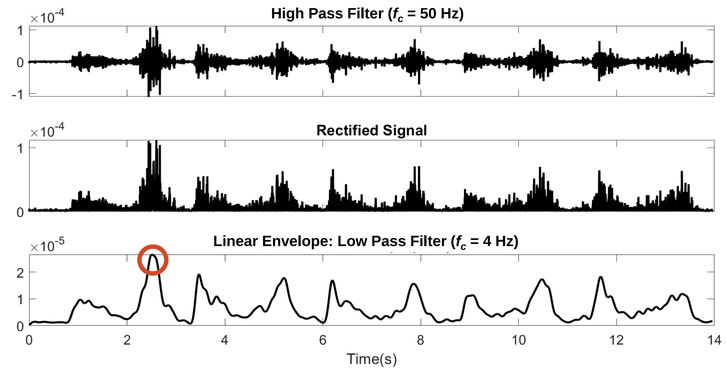


One 5xSTS trial was conducted per participant.



Marker Trajectory Filter (low pass f_c= 6 Hz)
GRFs Filter (low pass f_c= 6 Hz)
Seat On and Seat Off Threshold (Weight of the stool)
Time to Completion (First seat off to last seat on)
Joint Moments (Third cycle of 5xSTS)
Hip, knee, & ankle, peak flexion & extension

EMG Processing



$$iEMG = \int_{t(First\ Seat\ Off)}^{t(Last\ Seat\ On)} \frac{5xSTS\ EMG\ Signal}{Max\ 5xSTS\ EMG}\ dt$$

Statistical Analysis

Unpaired t-test (α=0.05) between younger and older groups for:

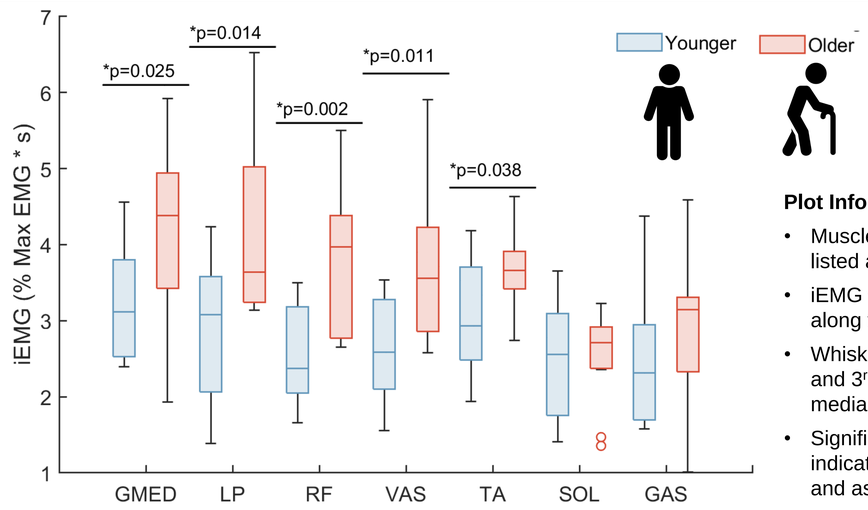
- ***Time to Completion***
- ***Muscle iEMG***
- ***Peak Joint Moments (Third Cycle)***

Results

Time to Completion

No difference between the groups (p = 0.473).

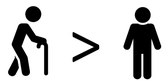
Muscle iEMG



Plot Information:

- Muscle abbreviations listed along the x-axis.
- iEMG value plotted along the y-axis.
- Whiskers represent 1st and 3rd quartiles, line is median.
- Significant difference is indicated with p-value and asterisk.

iEMG for GMED, LP, RF, VAS, &TA:

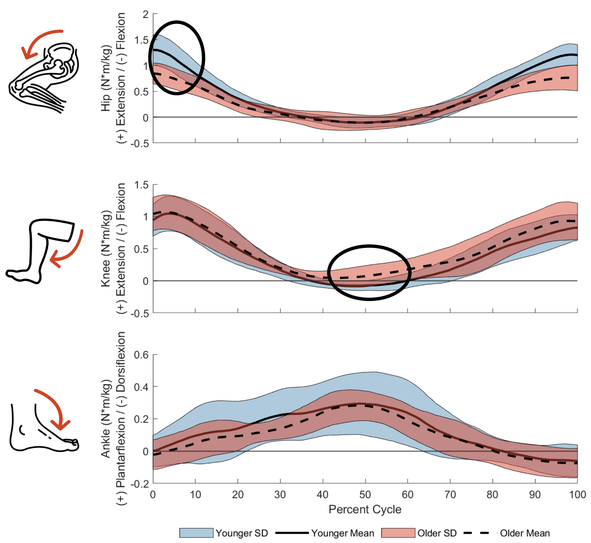


May indicate a compensation due to muscle weakness or muscle activation timing [2,3].

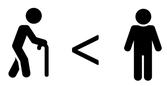
SOL & GAS: no difference

Likely caused by feet planted during the task.

Peak Joint Moments (Third Cycle)



Peak Hip Extension (p<0.001) & Knee Flexion (p=0.013) :



Peak Ankle, Knee Extension, & Hip Flexion: no difference

*Circled in plots above.

Conclusions

Older adults required greater muscle iEMG to complete the 5xSTS task in a similar amount of time as the younger participants.

- Altered rising strategy in older adults
- Time to complete task does not explain the difference in iEMG

Younger adults have greater or similar peak hip, knee, and ankle joint moments during 5xSTS.

- Greater iEMG in older adults did not produce greater joint moments

Fall risk prevention training may be improved by assessing muscle coordination during the 5 Times Sit-to-Stand.

Acknowledgments

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References

[1] "WHO global report on falls prevention in older age," WHO, 2007.
[2] M. Arvin, et al., 2017
[3] P. C. Santos, et al., 2021