THE INFLUENCE OF AGE ON THE LOAD-VELOCITY PROFILE ACROSS THE AGE SPAN IN FEMALES

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Introduction

With aging comes significant declines in muscle size, muscle strength, muscle power, and overall functional ability (3, 4). Starting between the age of 40 and 50 years old through the age of 80, about 50% of muscle mass is lost (8). Resistance training programs are recommended to help mitigate these declines in performance (2, 5, 7). To combat the age-related declines in muscle strength, a load-velocity (LV) relationship can be generated based on how much load an individual can lift and how fast they can lift that load (1, 6).

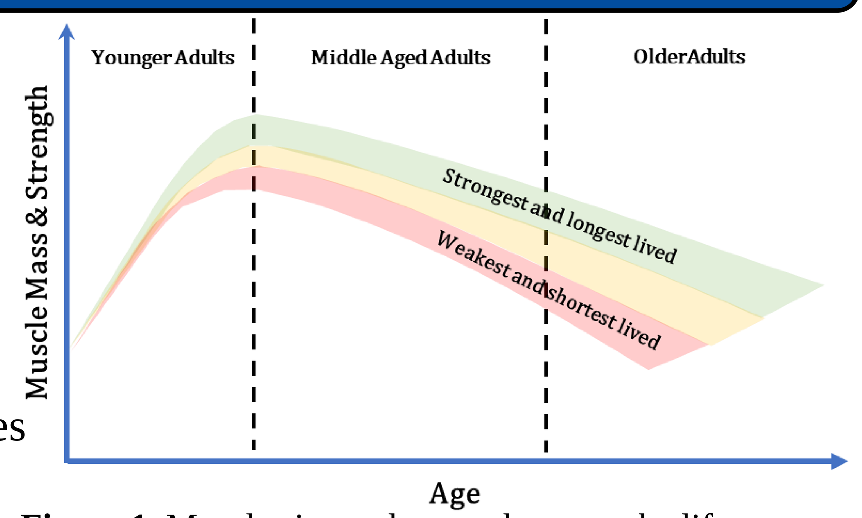

Figure 1. Muscle size and strength across the life course. Figure adapted from Cruz-Jentoft et al. 2019[9]

The slope generated from a LV relationship has traditionally been used to assess adaptations in individual's overall performance. However, recent pilot data from out lab suggests that the area under the LV curve may provide a more accurate assessment of performance adaptations compared to slope in older adults. However, there has been a paucity of research examining at the LV relationship across the age-span in females.

Therefore, the purpose of this study was to examine the influence of age on the LVP in females.

Methods

Participants: Twenty-seven female participants ranging from 19+ years of age volunteered to participate in this study. Individuals who met the following criteria were considered for the study:

- Free of neuromuscular/circulatory/edema pathology
- No lower extremity injury or surgery 6 months prior to participating in the study
- Capable of performing physical exercise and/or activities of daily living
- Not currently involved in a structured resistance exercise for at least 6 months prior to testing

Load Velocity Assessment:
Participants completed the Load Velocity (LV) assessment following a familiarization warmup on the belt squat on their visit to the lab. Knee angle was standardized at 110 degrees and squat safety height was determined and adjusted for each participant. Participants were instructed to move as fast as possible for each repetition. Three repetitions were completed at each set with each set's load increasing by 20% of their body weight, starting with an initial load of the rack (31 lbs). The average velocities of each repetition for the concentric movements were recorded. Repetitions were adjusted based on movement velocity. A 2-minute rest was given in between sets. The data collected was used to examine the influence of age on the LVP.

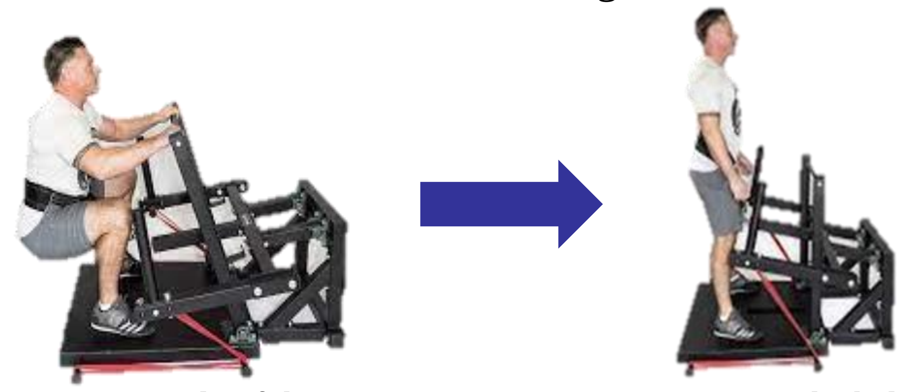

Figure 1. Example of the resistance training movement on the belt squat

Load Velocity Characteristics:
Participants' absolute and relative 1RM strength, maximal movement speed (determined as highest mean velocity achieved during the initial load) were assessed. Using the mean velocity of each trial at each load, a linear regression equation was created using relative load (kg/BW) with respect to mean velocity to provide a LV slope and intercept. The area under the LV regression curve (LV area) was calculated using the trapezoidal method.

Statistical Analysis & Results

A one-way ANOVA was run. Hedges' g effect size was used to estimate effect size.

No significant differences were discovered in SLOPEabs (F=2.19, p=0.13) and SLOPErel (F=2.12, p=0.156). However, significant group differences were revealed in AUCabs (F=11.19, p=0.002), AUCrel (F= 9.64, p=0.006), Maximal Strength (F=13.56, p=<0.001), REL 1 RM (F=13.17, p=<0.001), and Maximal Velocity (F=9.24, p=<0.00). Post-hoc analysis revealed significant differences in AUCabs between YF and OF (p= <0.001), as well as significant differences in AUCrel between YF and OF and MF and OF (p=<0.001, p=0.01), respectively. Additionally, post-hoc analysis revealed differences between YF and OF in Maximal Strength, REL 1 RM, and Maximal Velocity (p=<0.001, p=<0.001, p=0.007), respectively. Further significant differences were revealed in REL 1 RM between YF and MF and between YF and OF (p=0.003, p=< 0.001), respectively.

Table 1. Demographics

	n (#)	Age (yrs)	Height (cm	Weight (kg	BMI
YF	12	24 ± 7	170 ± 5	71 ± 12	25 ± 4
MF	8	52 ± 5	168 ± 7	78 ± 16	27 ± 4
OF	12	70 ± 4	164 ± 6	67 ± 14	25 ± 5

BMI - Body mass index, YF = young females, MF = middle aged females, OF = Older females

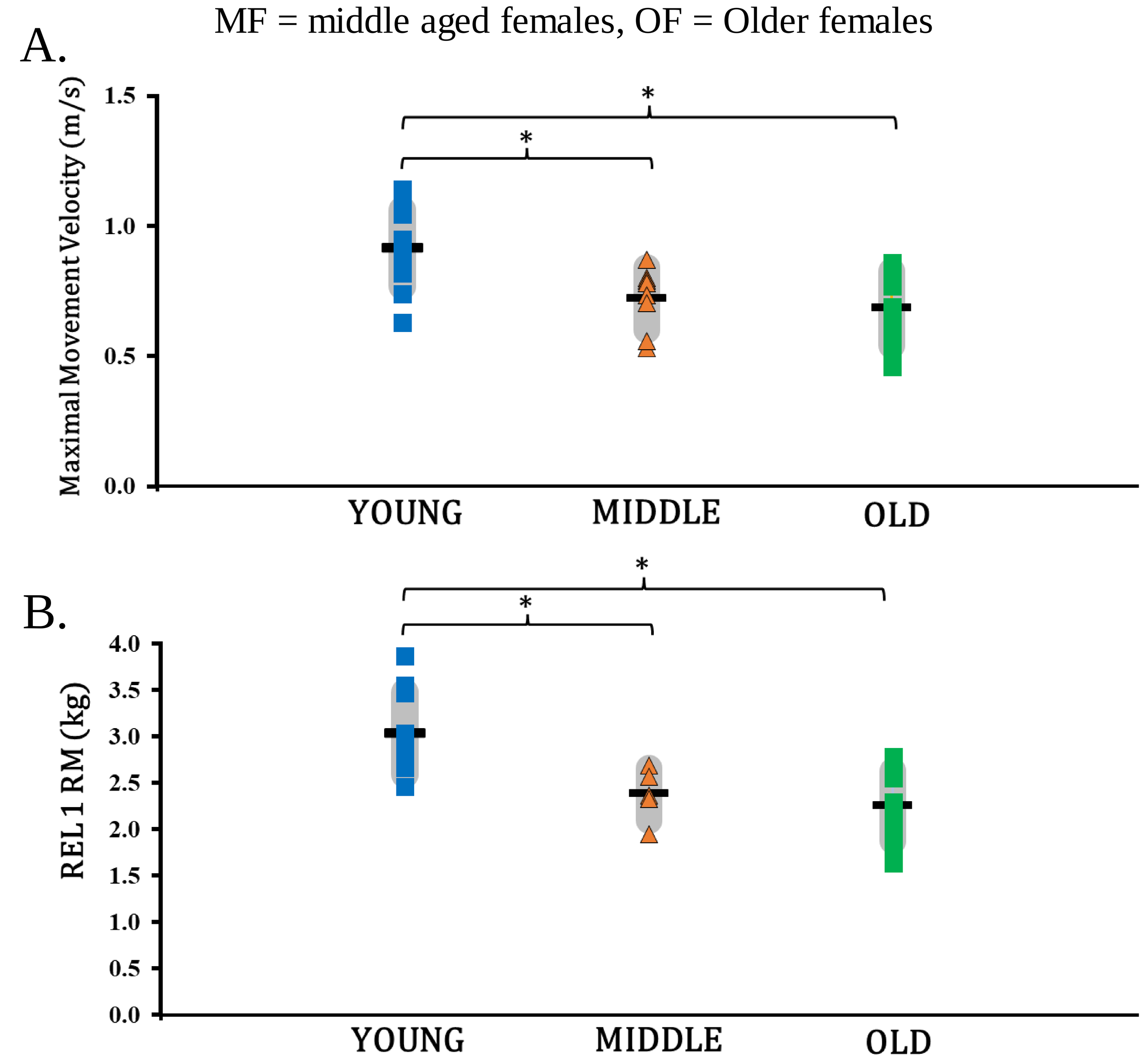

Figure 2 . (A) Maximal Movement Velocity between YF (blue), MF (orange), and OF (green). (B) Differences in REL 1 RM between YF (blue), MF (orange), and OF (green).

Table 2. Effect sizes Relative Strength

	YF	MF	OF
YF	-		
MF	3.23	-	
OF	4.23	1.33	-

Table 3. Effect sizes max velocity

	YF	MF	OF
YF	-		
MF	2.99	-	
OF	3.29	0.55	-

Table 4. Effect sizes Relative Slope

	YF	MF	OF
YF	-		
MF	1.25	-	
OF	0.39	0.11	-

Table 5. Effect sizes Absolute Slope

	YF	MF	OF
YF	-		
MF	0.72	-	
OF	1.72	0.98	-

Table 6. Effect sizes Relative AUC

	YF	MF	OF
YF	-		
MF	-3.54	-	
OF	-4.77	-1.44	-

Table 7. Effect sizes Absolute AUC

	YF	MF	OF
YF	-		
MF	-2.32	-	
OF	-5.66	-2.38	-

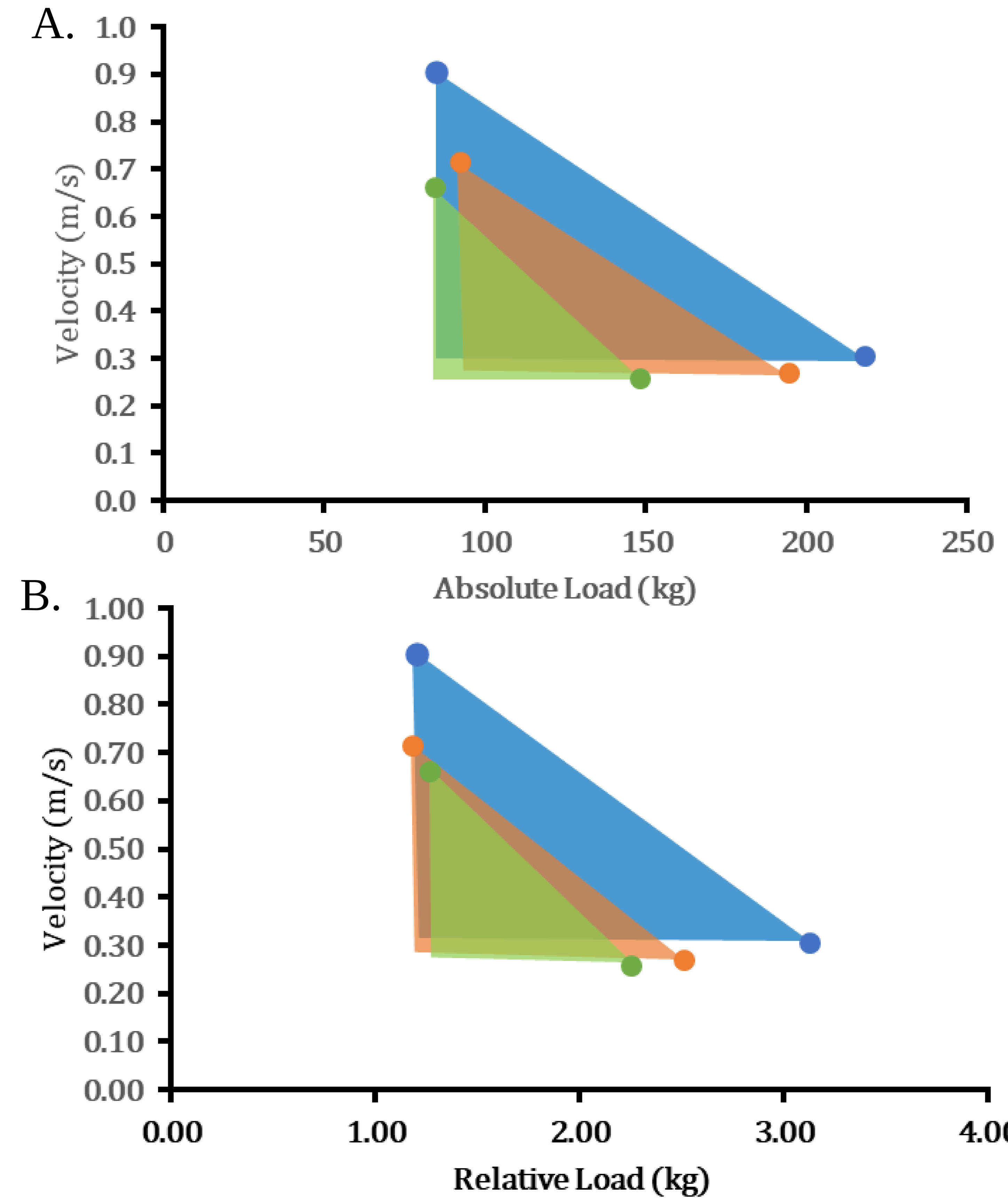

Figure 3 . (A) Load Velocity relationship and AUCabs between YF (blue), MF (red), and OF (green). (B) LV relationship and AUCrel between YF (blue), MF (red), and OF (green).

Conclusions

These data suggest that there are significant differences in Maximal Strength, REL 1 RM, Maximal Movement Velocity, AUCabs, and AUCrel across the age span in females. These data also suggest that, due to the small effect sizes and no significant differences in SLOPEabs and SLOPErel across the age span, AUCabs and AUCrel might be a better indicator for differences between age groups in the Load Velocity relationship.

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