SEX DIFFERENCES IN FORCE OUTPUT AND MUSCLE EXCITATION OF ELBOW FLEXORS ACROSS A BOUT OF BLOOD FLOW RESTRICTED EXERCISE

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Introduction & Purpose

While sex-differences in fatiguability and exercise performance have been well-documented, numerous factors have been shown to mediate the magnitude of sex-related differences[1]. A recent increase in the popularity of blood-flow restriction (BFR) exercise has created a need for further examination of the potential sex-related differences in BFR exercise. Previous research has indicated that BFR may preferentially target type I muscle fibers[2], which have been shown to be more prevalent in females when compared to males[3]. Thus, it may be hypothesized that sex-related differences in neuromuscular function throughout an acute bout of BFR exercise may exist. Therefore, **the purpose of this investigation was to examine sex-differences in force output and muscle excitation during the first (FR) and last (LR) repetitions of 4 sets of low-load BFR elbow flexion exercise.**

Methods

Thirteen females (Mean ± SD; Age: 21 ± 2 y) and 14 males (Age: 23 ± 3 y) who had been participating in structured resistance training for a minimum of 6 months volunteered to participate in this investigation. At least 48 hours following one-repetition maximum (1RM) testing, subjects completed maximal voluntary isometric contraction (MVIC) strength testing of the elbow flexors of their dominant arm followed by an acute bout of exercise with BFR at 60% arterial occlusion pressure. For the exercise bout, subjects completed 4 sets of repetitions (30/15/15/15) at 30% 1RM with 30 seconds of rest between sets. EMG amplitude and force were collected during MVIC and throughout the exercise bout. Peak force (PF) and normalized EMG amplitude ($nEMG_{AMP}$; %MVIC) were calculated offline during the first (FR) and last (LR) repetitions of each set.

Results

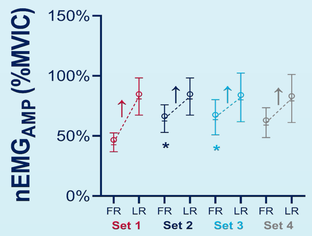

Figure 1. Mean ± 95% confidence intervals for normalized EMG amplitude ($nEMG_{AMP}$) during the first (FR) and last (LR) repetitions of each set for female participants.
↑Indicates significant increase in $nEMG_{AMP}$ during set
*Indicates significantly greater $nEMG_{AMP}$ during FR than set 1
*Indicates significantly lower $nEMG_{AMP}$ during FR than all other sets
#Indicates significantly greater $nEMG_{AMP}$ during LR than set 3 and set 4
†Indicates significantly greater $nEMG_{AMP}$ during LR than all other sets

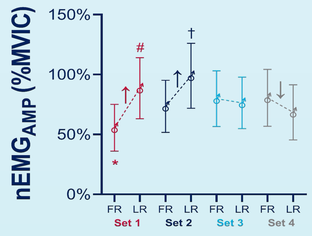

Figure 2. Mean ± 95% confidence intervals for normalized EMG amplitude ($nEMG_{AMP}$) during the first (FR) and last (LR) repetitions of each set for male participants.
↑Indicates significant increase in $nEMG_{AMP}$ during set
↓Indicates significant decrease in $nEMG_{AMP}$ during set

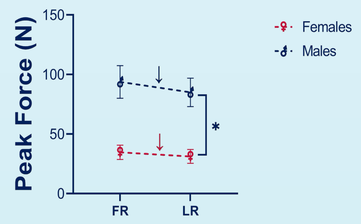

Figure 3. Mean ± 95% confidence intervals for peak force (PF) during first (FR) and last (LR) repetitions when collapsed across set.
*Indicates significantly greater PF in males at both timepoints
↓Indicates significant decrease in PF from FR to LR

There was a significant condition × repetition × sex interaction effect for $nEMG_{AMP}$ ($p<0.001$). Post-hoc analyses indicated that in females, $nEMG_{AMP}$ significantly increased from FR to LR during each set (S1: +35.8%; S2: +18.4%; S3: +16.5%; S4: +20.2%; $p<0.001$-0.011). However, in males, $nEMG_{AMP}$ significantly increased from FR to LR in S1 (+33.0%; $p<0.001$) and S2 (+25.5; $p<0.001$), non-significantly decreased during S3 (-3.5%; $p=0.492$) before significantly decreasing during S4 (-12.1%; $p=0.031$). Across sets, females exhibited significantly lower $nEMG_{AMP}$ during FR at S1 (44.7±13.0%) when compared to S2 (64.4±19.0%; $p=0.018$) and S3 (65.6±24.2%; $p=0.023$), but not S4 (61.0±20.5%; $p=0.109$). Males displayed significantly lower $nEMG_{AMP}$ at S1 (55.5±33.8%) during FR when compared to all other sets (S2: 73.4±37.7%; S3: 79.8±40.2%; S4: 80.5±41.2%; $p=0.003$-0.028). While there were no differences in $nEMG_{AMP}$ during LR in females ($p>0.05$ for all), $nEMG_{AMP}$ during LR of S1 (88.5±44.3%) was significantly lower than S2 (98.9±47.0%; $p=0.028$), but greater than S3 (76.3±37.3%; $p=0.004$) and S4 (68.4±40.0%; $p=0.003$) in males. $nEMG_{AMP}$ was also significantly greater at LR during S2 when compared to S3 and S4 ($p<0.001$-0.012) in males. There were no significant differences in $nEMG_{AMP}$ between sexes at any timepoint ($p=0.137$-0.678). There were no 3-way interaction effects for PF ($p=0.681$), but there was a significant rep × sex interaction effect for PF ($p<0.001$). Post-hoc analyses determined that PF significantly declined from FR to LR in both males (FR: 93.8 ± 23.7 N; LR: 85.0 ± 20.7 N; $p<0.001$) and females (FR: 34.7±9.9 N; LR: 31.2±9.6 N; $p<0.001$), when collapsed across set. Males also exhibited significantly greater PF at both timepoints ($p<0.001$ for both).

Conclusions

Our data suggest the presence of a sex-related difference in neuromuscular fatigue throughout an acute bout of low-load exercise with BFR. While both males and females displayed significant reductions in PF throughout the exercise bout, there was a divergent time-course of changes in $nEMG_{AMP}$ between males and females across 4 sets of BFR elbow flexion exercise.

Practical Applications

Practitioners should be aware that males and females appear to exhibit different alterations in neuromuscular function across an acute bout of BFR exercise. Further investigation is needed to determine the mechanisms underlying the sex-related differences observed in this study and to determine if the pattern persists across other muscle groups and exercises.

References & Funding

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This project was funded by the University of South Alabama's Summer Undergraduate Research Fellowship and Bukstein Fellowship.