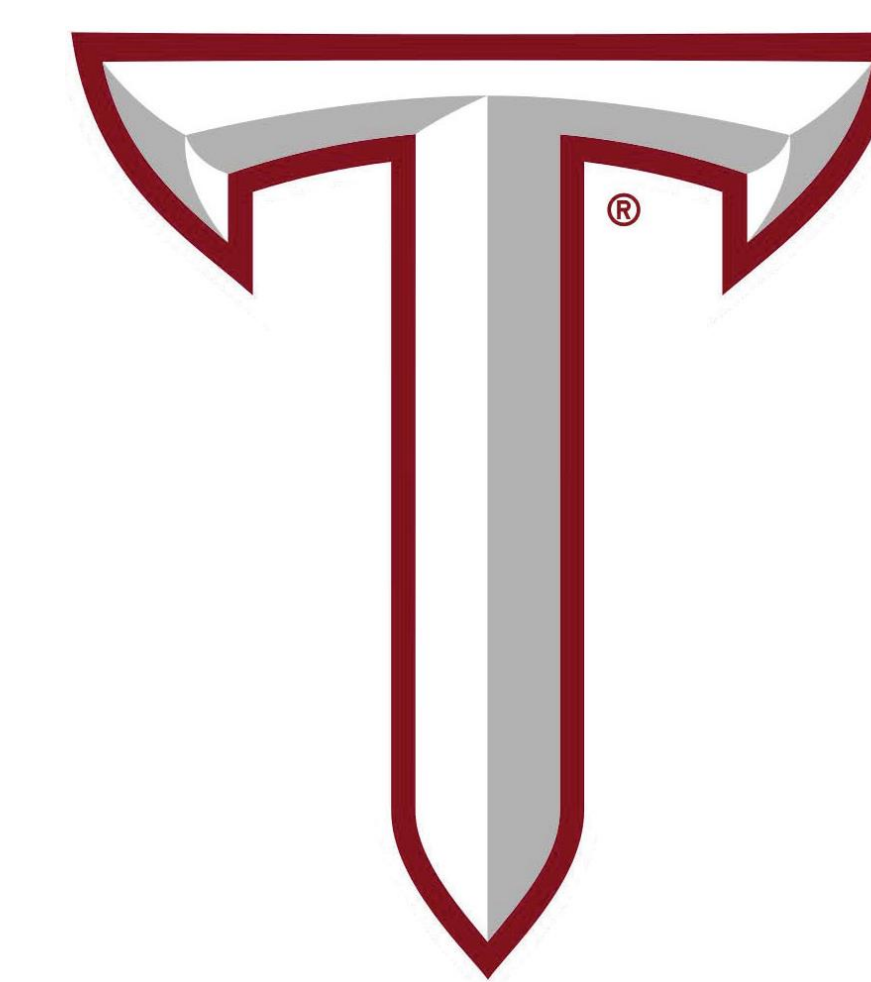


# COMPARISON OF MUSCLE ACTIVITY DURING JUDO/JIU-JITSU SPECIFIC PULL-UP AND NEUTRAL PULL-UP GRIPS

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## INTRODUCTION

Judo and jiu-jitsu are grappling-based systems of combat traditionally performed in a heavy cotton jacket (kimono/gi). A kimono/gi wrapped around a pull-up bar can be used to conduct sport-specific grip endurance and strength tests (1-5). No studies have compared the electrical activity (EA) during pull-ups utilizing a neutral grip (NPUG) to those utilizing a judo/jiu-jitsu specific grip (JPUG).

## PURPOSE

In order to assess the degree to which a JPUG challenges the hand flexor (HF) and biceps brachii (BB) musculature, this study investigated the EA of the HF and BB muscle groups while utilizing NPUG and JPUG. It was hypothesized that there would be higher HF muscle EA in JPUG compared to NPUG, but similar EA in the BB between grips.

## METHODS

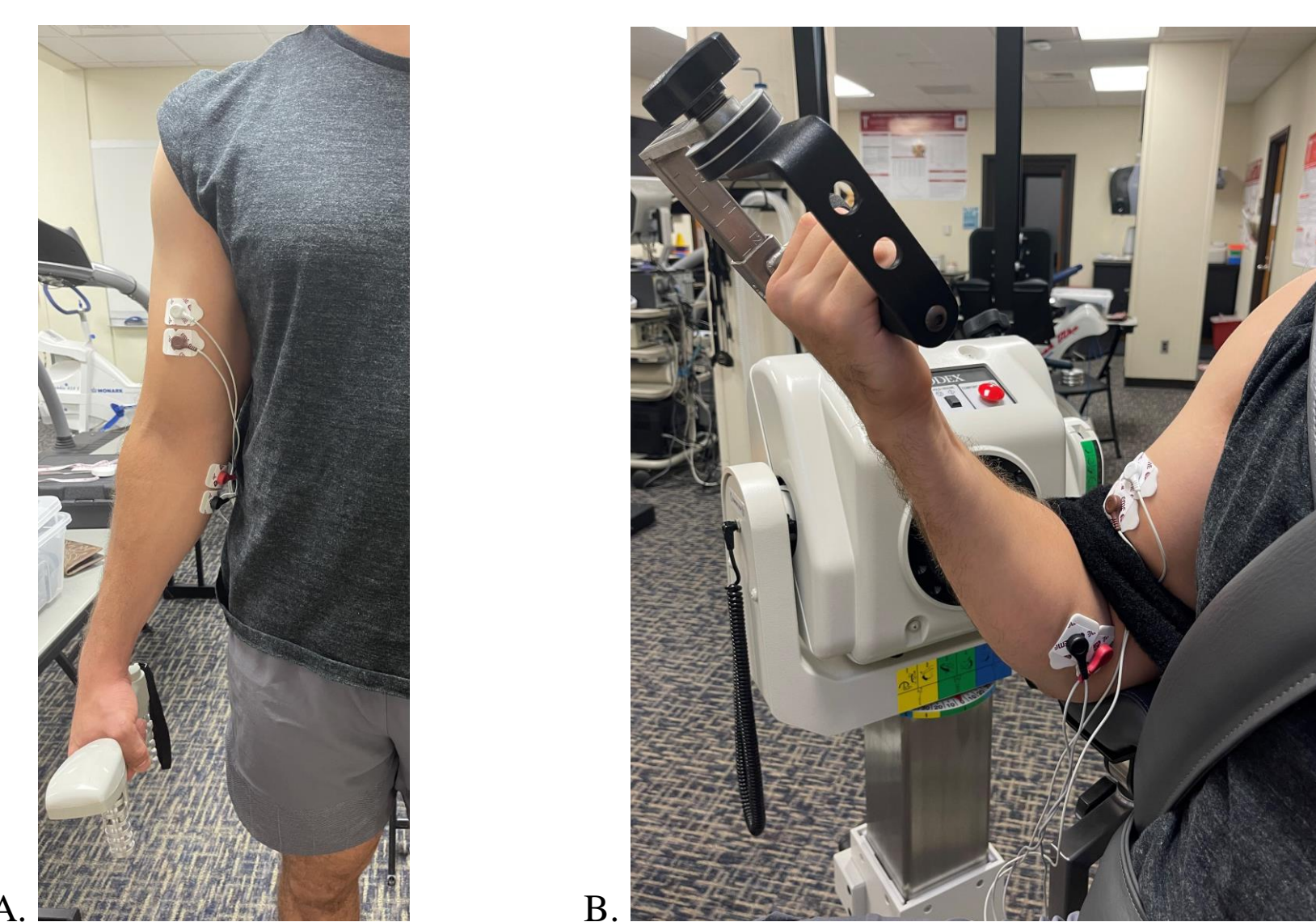
Eighteen participants ((mean ± SE): age = 20.8 ± 0.3 yr, height = 175.9 ± 1.4 cm, body mass = 82.1 ± 3.1 kg, body fat = 12.7 ± 1.5 %, grip strength = 53.0 ± 2.2 kg, NPUG repetition maximum (RM) = 8.8 ± 0.8, JPUG RM = 8.5 ± 0.7) were randomly assigned to perform NPUG and JPUG 24 hr apart using a randomized within-subjects, cross-over design. Surface electromyography (sEMG) was measured on the HF and BB during maximal isometric voluntary contractions (MIVC) prior to each trial, followed by NPUG or JPUG repetitions (reps) to failure. For each participant, the average sEMG of the first five reps for NPUG and JPUG was calculated and divided by the MIVC recorded at the respective visit for the HF and BB to determine the relative activity (RA; %). Separate 2 × 5 (Grip × Rep) RMANOVAs were used to evaluate the effects of grip and rep on EA. Separate dependent *t* tests were used to evaluate RA of the HF and BB between grips. Significance was set at *p* ≤ .05.

### Descriptive Characteristics of Participants

<i>n</i>	Age (years)	Mass (kg)	Height (cm)	Body fat (%)	Grip Str.* (kg)	RM NPUG* (reps)	RM JPUG* (reps)
18	20.8 ± 0.3	82.1 ± 3.1	175.9 ± 1.4	12.7 ± 1.5	53.0 ± 2.2	8.8 ± 0.8	8.5 ± 0.7

Note. Values are mean ± standard error. Str. = Strength; RM = repetition maximum; NPUG = neutral pull-up grip; JPUG = judo/jiu-jitsu specific pull-up grip.  
\*Preliminary visit.

### Hand Flexors and Biceps Brachii Maximal Isometric Voluntary Contractions



Note. Panel A: Maximal isometric voluntary contraction (MIVC) measurement of the hand flexors using a hand dynamometer. Panel B: MIVC measurement of the biceps brachii using an isokinetic dynamometer.

### Electrical Activity of the Hand Flexors and Biceps Brachii When Performing Maximal Isometric Voluntary Contractions

NPUG Experimental Visit		JPUG Experimental Visit	
Hand Flexors MIVC sEMG (mV)	Biceps Brachii MIVC sEMG (mV)	Hand Flexors MIVC sEMG (mV)	Biceps Brachii MIVC sEMG (mV)
0.072 ± 0.008	0.442 ± 0.050	0.076 ± 0.008	0.432 ± 0.058

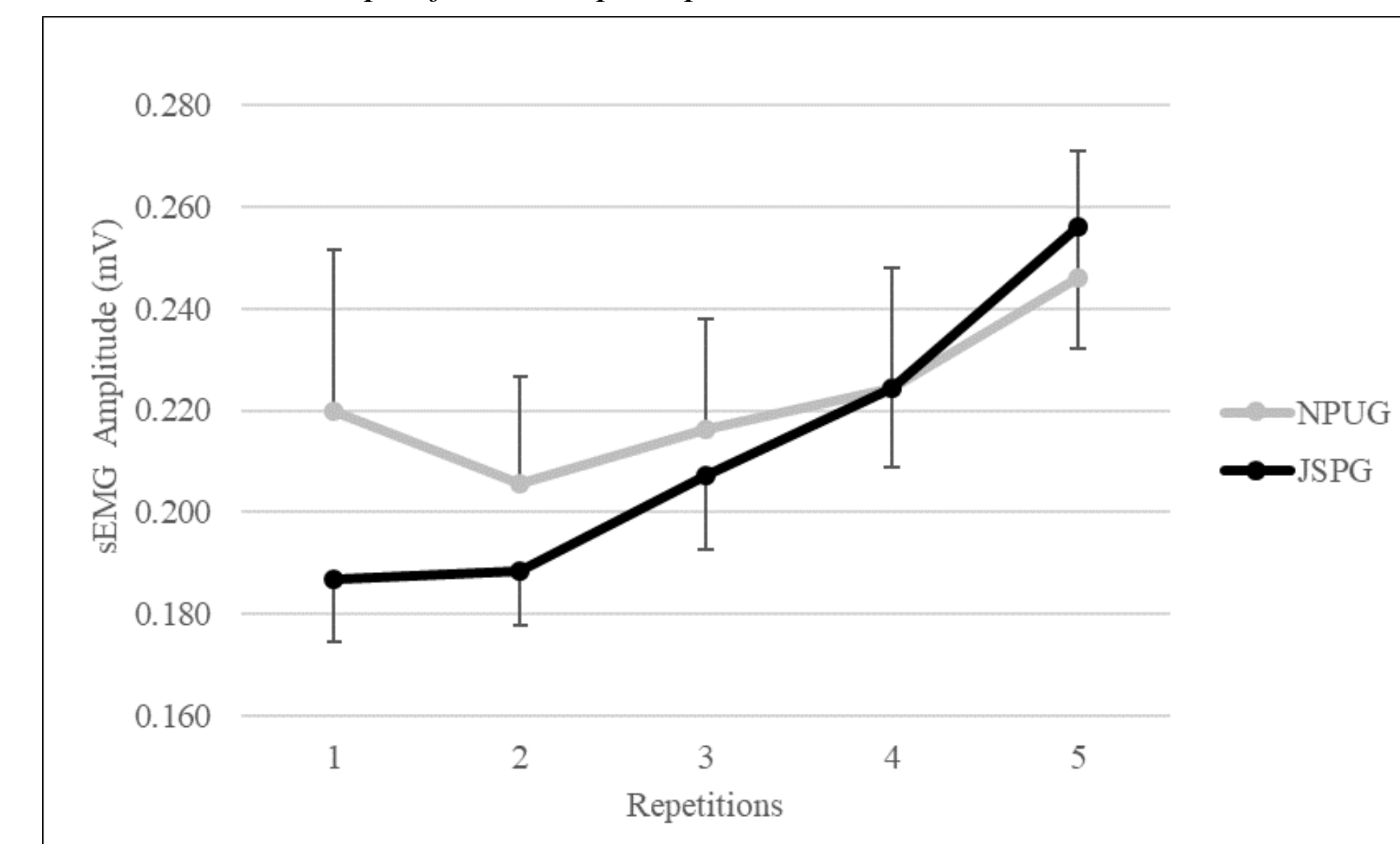
Note. Values are mean ± standard error; *n* = 18 for neutral pull-up grip (NPUG) and judo/jiu-jitsu specific pull-up grip (JPUG). MIVC = maximal isometric voluntary contraction; sEMG = surface electromyography amplitude.

### Set-Up for Judo/Jiu-Jitsu Specific Pull-Up Grip



Note. Panel A: Posterior view of judo/jiu-jitsu specific pull-up grip (JPUG). Panel B: Lateral view of JPUG.

### Electrical Activity of the Biceps Brachii When Performing the Neutral Pull-Up Grip and the Judo/Jiu-Jitsu Specific Pull-Up Grip



Note. Values are mean ± standard error; *n* = 18 for neutral pull-up grip (NPUG) and judo/jiu-jitsu specific pull-up grip (JPUG). sEMG = surface electromyography amplitude. Main effect of rep (*p* = 0.002). No main effect of grip (*p* = 0.408). No rep × grip interaction (*p* = 0.541).

### Electrical Activity of the Hand Flexors When Performing the Neutral Pull-Up Grip and the Judo/Jiu-Jitsu Specific Pull-Up Grip

Pull-Up Grip	Pull-Up Repetitions					
	Rep 1 sEMG (mV)	Rep 2 sEMG (mV)	Rep 3 sEMG (mV)	Rep 4 sEMG (mV)	Rep 5 sEMG (mV)	Reps 1-5 Avg. sEMG* (mV)
NPUG	0.099 ± 0.010	0.104 ± 0.010	0.116 ± 0.011	0.128 ± 0.014	0.136 ± 0.014	0.117 ± 0.011
JPUG	0.110 ± 0.008	0.128 ± 0.009	0.139 ± 0.010	0.153 ± 0.012	0.161 ± 0.013	0.138 ± 0.010

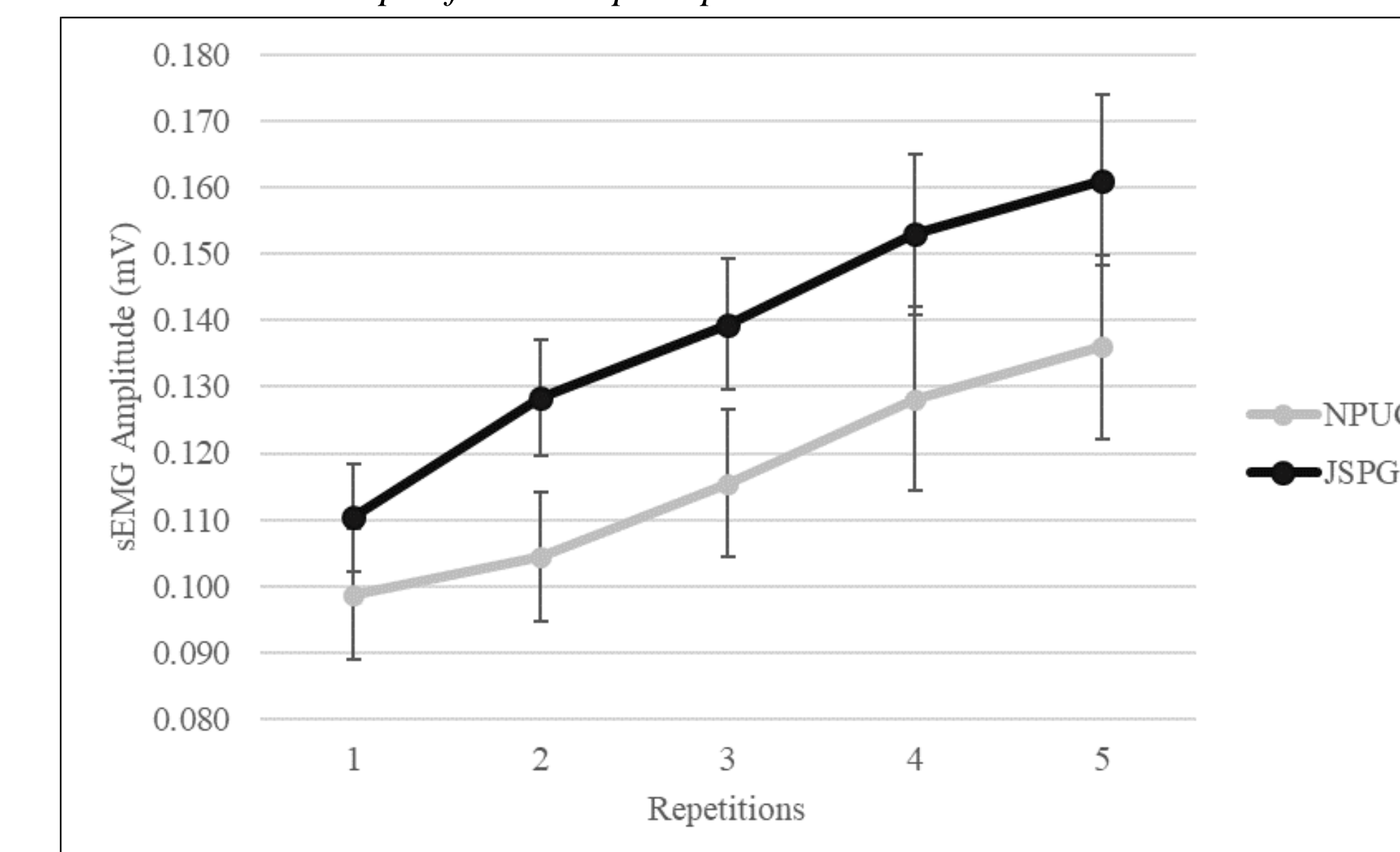
Note. Values are mean ± standard error; *n* = 18 for neutral pull-up grip (NPUG) and judo/jiu-jitsu specific pull-up grip (JPUG). The repetition maximum (RM) = 10.11 ± 0.74 and 7.28 ± 0.58 for NPUG and JPUG, respectively. Rep = Repetition; sEMG = surface electromyography amplitude; RM = repetition maximum. Main effect of rep (*p* < 0.001). Main effect of grip (*p* = 0.025). No rep × grip interaction (*p* = 0.170). \*For each participant, the average sEMG amplitude of their first five pull-up reps for each pull-up condition (i.e., NPUG and JPUG, respectively) was calculated, then the mean ± standard error was calculated for the NPUG and JPUG, respectively.

### Grip Placement for Neutral Pull-Up Grip and Judo/Jiu-Jitsu Specific Pull-Up Grip



Note. Panel A: Anterior view of neutral pull-up grip. Panel B: Anterior view of judo/jiu-jitsu specific pull-up grip.

### Electrical Activity of the Hand Flexors When Performing the Neutral Pull-Up Grip and the Judo/Jiu-Jitsu Specific Pull-Up Grip



Note. Values are mean ± standard error; *n* = 18 for neutral pull-up grip (NPUG) and judo/jiu-jitsu specific pull-up grip (JPUG). sEMG = surface electromyography amplitude. Main effect of rep (*p* < 0.001). Main effect of grip (*p* = 0.025). No rep × grip interaction (*p* = 0.170).

### Electrical Activity of the Biceps Brachii When Performing the Neutral Pull-Up Grip and the Judo/Jiu-Jitsu Specific Pull-Up Grip

Pull-Up Grip	Pull-Up Repetitions					
	Rep 1 sEMG (mV)	Rep 2 sEMG (mV)	Rep 3 sEMG (mV)	Rep 4 sEMG (mV)	Rep 5 sEMG (mV)	Reps 1-5 Avg. sEMG* (mV)
NPUG	0.220 ± 0.032	0.206 ± 0.021	0.216 ± 0.021	0.230 ± 0.023	0.246 ± 0.025	0.224 ± 0.020
JPUG	0.187 ± 0.012	0.188 ± 0.011	0.207 ± 0.014	0.225 ± 0.016	0.256 ± 0.024	0.213 ± 0.014

Note. Values are mean ± standard error; *n* = 18 for neutral pull-up grip (NPUG) and judo/jiu-jitsu specific pull-up grip (JPUG). The repetition maximum (RM) = 10.11 ± 0.74 and 7.28 ± 0.58 for NPUG and JPUG, respectively. Rep = Repetition; sEMG = surface electromyography amplitude; RM = repetition maximum. Main effect of rep (*p* = 0.002). No main effect of grip (*p* = 0.408). No rep × grip interaction (*p* = 0.541). \*For each participant, the average sEMG amplitude of their first five pull-up reps for each pull-up condition (i.e., NPUG and JPUG, respectively) was calculated, then the mean ± standard error was calculated for the NPUG and JPUG, respectively.

### Relative Electrical Activity of the Hand Flexors and Biceps Brachii When Performing the Neutral Pull-Up Grip and the Judo/Jiu-Jitsu Specific Pull-Up Grip

NPUG Experimental Visit		JPUG Experimental Visit	
Hand Flexors Relative Activity* (%)	Biceps Brachii Relative Activity* (%)	Hand Flexors Relative Activity* (%)	Biceps Brachii Relative Activity* (%)
186.3 ± 24.1	60.0 ± 7.2	223.2 ± 34.6	64.6 ± 9.3

Note. Values are mean ± standard error; *n* = 18 for neutral pull-up grip (NPUG) and judo/jiu-jitsu specific pull-up grip (JPUG). MIVC = maximal isometric voluntary contraction; Reps = Repetitions; sEMG = surface electromyography amplitude; RM = repetition maximum.

\*For each participant, the average sEMG amplitude of their first five pull-up reps for each pull-up condition (i.e., NPUG and JPUG, respectively) was calculated and was divided by their MIVC amplitude recorded at the respective visit (i.e., NPUG or JPUG) for the hand flexors and the biceps brachii, then multiplied by 100 to determine the relative activity (%) of each (i.e., hand flexors and biceps brachii). The mean ± standard error was calculated for NPUG and JPUG, respectively.

## RESULTS

For the HF, there was no interaction (*p* = .170). There was a main effect of rep (Rep 1 < Rep 2 < Rep 3 < Rep 4 < Rep 5, *p* < .0005) and grip (JPUG > NPUG, *p* = .025). For the BB, there was no interaction (*p* = .541). There was a main effect of rep (Rep 2 < Rep 3 < Rep 4 < Rep 5, *p* = .002), but no main effect of grip (*p* = .408). Results of the dependent sample *t* tests indicated no difference in the RA of the HF between NPUG (186.3 ± 24.1%) and JPUG (223.2 ± 34.6%) conditions (*p* = .19). In addition, there was no difference in the RA of the BB between NPUG (60.0 ± 7.2%) and JPUG (64.6 ± 9.3%) conditions, (*p* = .62).

## CONCLUSION

The present study indicates that both the NPUG and JPUG exhibited predictable and anticipated increases in EA in the HF and BB musculature as reps advanced throughout a set (i.e., increased muscular activity as fatigue increased). Higher HF EA was observed while using JPUG when compared to NPUG. However, similar EA was observed in the BB between the two grips.

## PRACTICAL APPLICATION

The results of this study suggest that utilizing a kimono/gi to facilitate a sport-specific, judo/jiu-jitsu pull-up grip involving a mid-acromion width grip with hands in a neutral position results in higher EA in the HF compared to a neutral, mid-acromion grip pull-up performed on a standard pull-up bar. Attempts at improving sport-specific strength and endurance of the forearm musculature, arguably an important determinant in the outcome of a match, should therefore incorporate a judo/jiu-jitsu pull-up grip.

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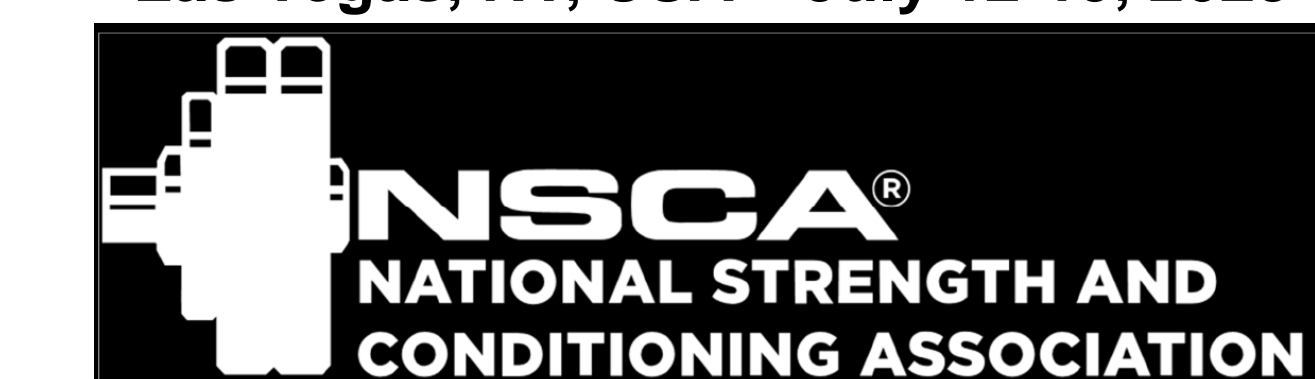
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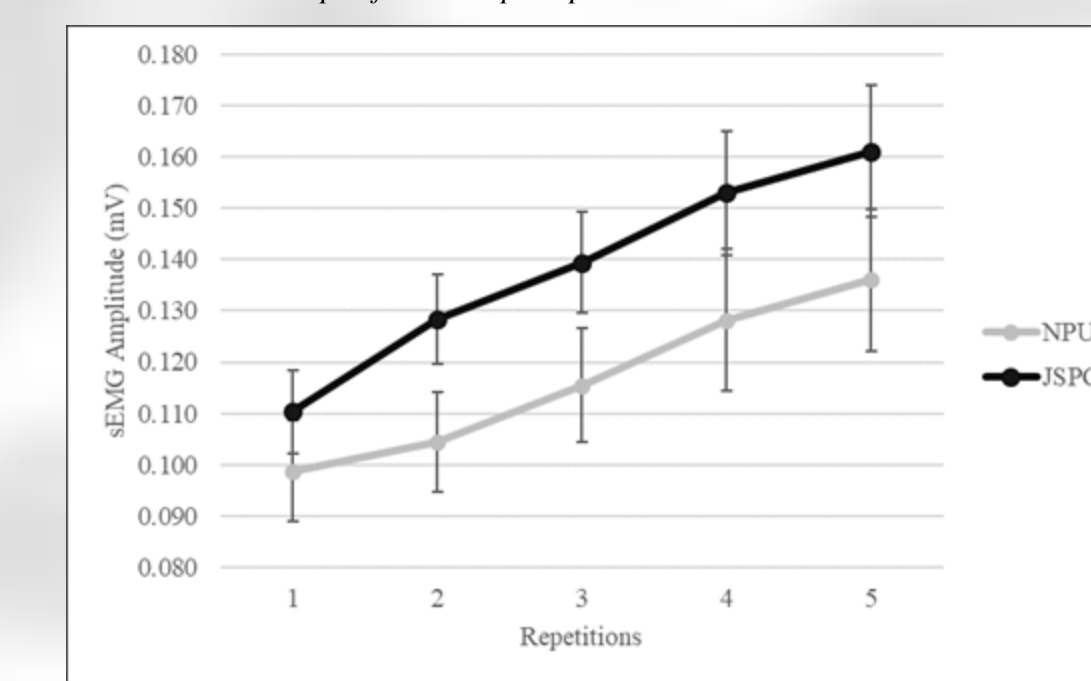


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Note: Values are mean  $\pm$  standard error,  $n = 18$  for neutral pull-up grip (NPU) and judo/jiu-jitsu specific pull-up grip (JSPG).  $\mu$ EMG = surface electromyography amplitude.  
Main effect of rep ( $p < 0.001$ ). Main effect of grip ( $p = 0.025$ ). No rep  $\times$  grip interaction ( $p = 0.170$ ).