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# **Strength and forearm volume differences in boulderers and sport climbers.**

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**Summary – Twenty-eight participants were divided into three groups: control (n=10), sport climbers (n=9) and boulderers (n=9) to investigate the determinants of grip strength between climbing disciplines. Forearm volume (FAV) was measured using water displacement method. Maximal volitional contraction (MVC) was assessed using an open crimp grip on a climbing specific fingerboard apparatus. There were no significant differences in FAV between disciplines. However, there was a significant main effect for MVC and MVC/FAV across all groups. Boulderers had higher MVC than sport (MD=7.5 CI=1.8-13.2) and controls (MD=17.7 CI= 11.9-23.6) and sport climbers was higher than controls (MD= 10.2 CI = 4.5-15.9. The findings suggest that the greater MVC seen in boulderers and sport climbers may be a result of neural adaptations, not muscular hypertrophy.**

## **INTRODUCTION**

Previous research suggests that bouldering should be treated as its own rock climbing discipline due to the potential physiological differences between sport climbing and bouldering [1, 4]. Although some components of performance are equally important for the disciplines, the physiological attributes of the component may be different. Grip strength is clearly important for both sport climbing and bouldering; however the strength and endurance aspects of this appear to differ between the disciplines. Boulderers have been found to have a higher MVC compared sport climbers, but the reason remains unclear [1, 3]. Therefore, the purpose of this study was to investigate whether an improved MVC seen in boulderers is a result of muscular hypertrophy.

## **METHOD**

Twenty-eight participants were divided into three groups: control (N=9), bouldering (N=9) and sport climbers (N=10). Average climbing ability for boulderers and sport climbers was 22 and 17 on the IRCRA reporting scale. Forearm volume was measured to the nearest 0.5mL using the water displacement method in a rested condition [2]. The hand was initially immersed and the water discarded. This was followed by immersion of the arm up to the elbow crease. The result was expressed as absolute volumes, and was normalized to handgrip strength. The maximal volitional contraction was performed using an open crimp on a modular rock climbing hold (Uprising Ventures, Christchurch, New Zealand), mounted on a climbing specific fingerboard apparatus. The participants were given

three attempts to achieve the highest score. One-way ANOVA and post hoc Bonferroni were used to determine potential differences in the dependent variables. The pairwise comparisons are displayed alongside mean difference (MD) and confidence intervals (CI).

## RESULTS

Significant main group effects were observed for MVC and MVC/FAV. There was no significant main effect for FAV. Pairwise comparisons revealed that boulderers had a significantly higher MVC than both sport climbers (MD=7.5 CI=1.8-13.2) and controls (MD=17.7 CI= 11.9-23.6). Sport climbers also had a significantly higher MVC than controls (MD= 10.2 CI= 4.5-15.9). The pairwise comparison also revealed that boulderers had a significantly higher MVC/FAV than both sport climbers (MD=0.006 CI=0.0-0.012) and controls (MD= 0.013 CI= 0.007-0.019), and that of sport climbers was also significantly higher than controls (MD= 0.007 CI=0.001-0.013).

**Table 1. Anthropometric and grip strength data.**

	Control	Sport climbing	Bouldering
Body fat %	16.97 ± 8.39	14.9 ± 7.96	10.01 ± 3.89
Circumference (cm)	26.67 ± 1.95	27.56 ± 1.91	29.17 ± 1.10*
Forearm Volume	968.7 ± 195.9	1026.3 ± 197.9	1115.9 ± 100.4
MVC (Kg)	19.2 ± 2.5	29.4 ± 4.0*	36.9 ± 6.9**
MVC/BW	0.26 ± 0.05	0.397 ± 0.06*	0.50 ± 0.08**
MVC (N) /FAV	0.20 ± 0.04	0.27 ± 0.05*	0.33 ± 0.05**

\* Significant different from control (p<0.05).

\*\* Significant different from control and sport (p<0.05).

## DISCUSSION

The main finding of this study is that boulderers have a significantly greater MVC and MVC/FAV compared to sport climbers. However, this may not be due to hypertrophy as no differences in FAV were found. This is in agreement with Fachini *et al.* (2013) who observed that boulderers had a higher MVC and rate of force development (RFD) than sport climbers. This may reflect chronic neural or muscular adaptations induced by several years of explosive muscle contractions that are required in bouldering [1]. Future studies should investigate the physiological or biomechanical mechanisms underpinning finger strength for a greater understanding of how to optimally train in order to improve performance in bouldering and sport climbing.

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