

Background & Purpose

Hand-grip measures are serving as a simple low-cost method to assess fore-arm strength in the general population and in climbers as well (Watts et al. 2004). Intermittent isometric handgrip exercises about 340 N lead to occluded fore-arm blood flow and average handgrip forces of >300 N for each hand were observed during vertical wall climbing (Quaine et al. 1999).

Thus, it appeared interesting to examine the time course of maximal isometric grip strength in climbers (with heart rate and perceived exertion response), depending on testing position, laterality and climbing level.

Design & Subjects

- Cross-sectional study
- Independent Parallel-group design with repeated measures (n=12) on 4 conditions

	Recreational climbers (RC, n=17)	Ambitious climbers (AC, n=11)	Total (n=28)
Gender [f/m]	3/14	0/11	3/25
Age [years]	25.1 ± 7.4	30.6 ± 8.2	27.2 ± 8.0
Height [m]	1.78 ± 0.05	1.81 ± 0.09	1.79 ± 0.07
BMI [kg/m ²]	21.5 ± 2.0	21.8 ± 1.9	21.6 ± 1.9
ape index	1.06 ± 0.23	1.01 ± 0.03	1.05 ± 0.18
climbing level [UIAA metric]	6.8 ± 0.5***	8.7 ± 0.6	7.6 ± 1.0
training frequency per week	2.0 ± 0.9	2.5 ± 1.1	2.2 ± 1.0

Material & Methods

Testing procedure:

- Randomly performed max. isometric handgrip strength tests in four positions (Left and right hand beside the trunk as well as left and right hand above the shoulder)
- 12 repetitive work-relief cycles (5 sec : 1 sec, Donath et al., 2011) per testing with heart rate and perceived exertion recordings

Outcome measure:

- Time course of the strength decline during the 4 hand-grip positions (Figure 1) in both groups (RC vs. AC)
- Calculated strength decrement index (SDI, %) during the 4 positions in both groups (Figure 2)

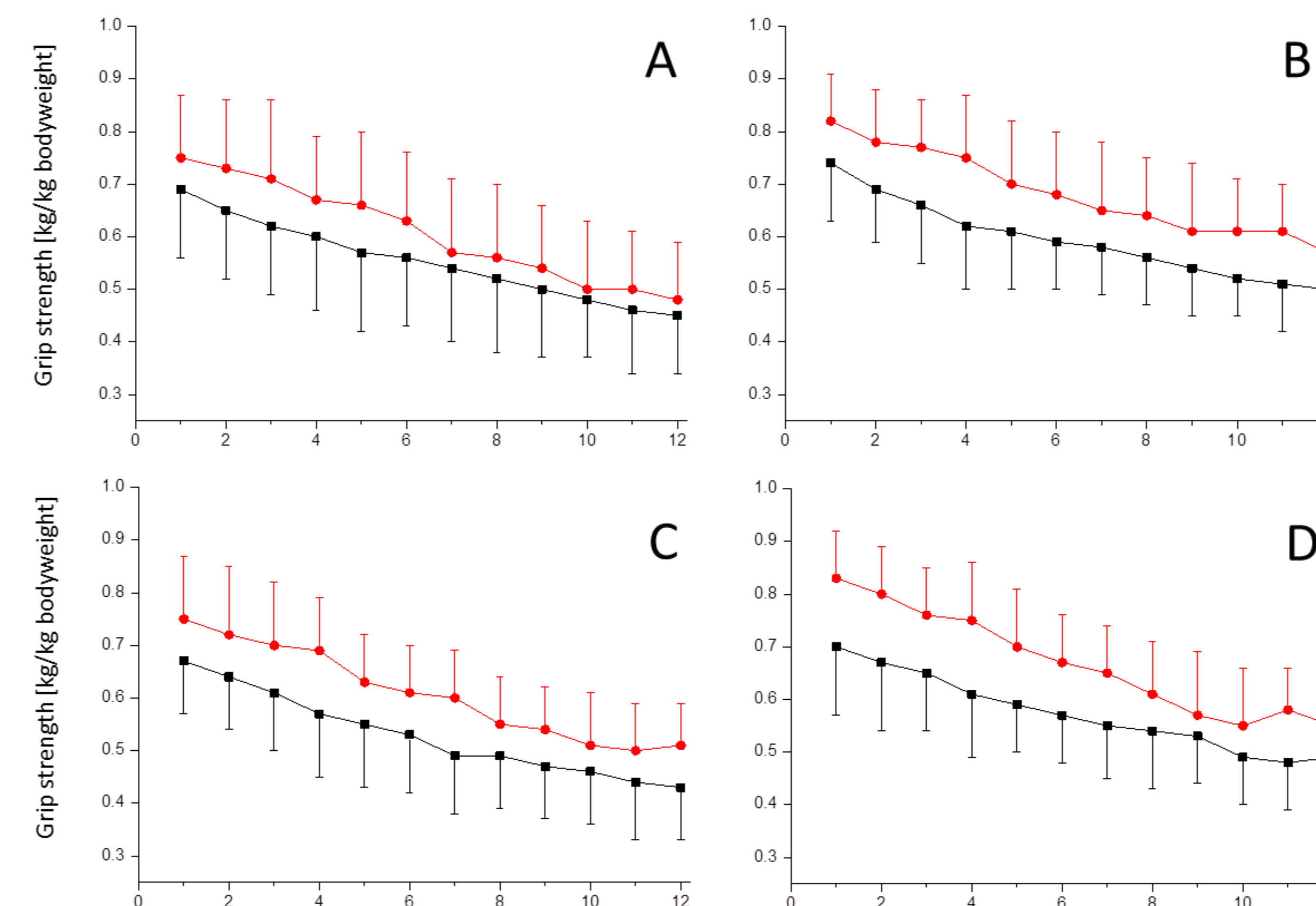


Figure 1. Relative force decline [kg/kg bodyweight] (Y-axis) within the 12 repetitive maximal contractions (X-axis) for ambitions (upper red line with circles) and recreational climbers (lower black line with squares) during the upper grip positions on the left (A) and right (B) side as well as the lower positions left (C) and right (D).

Results

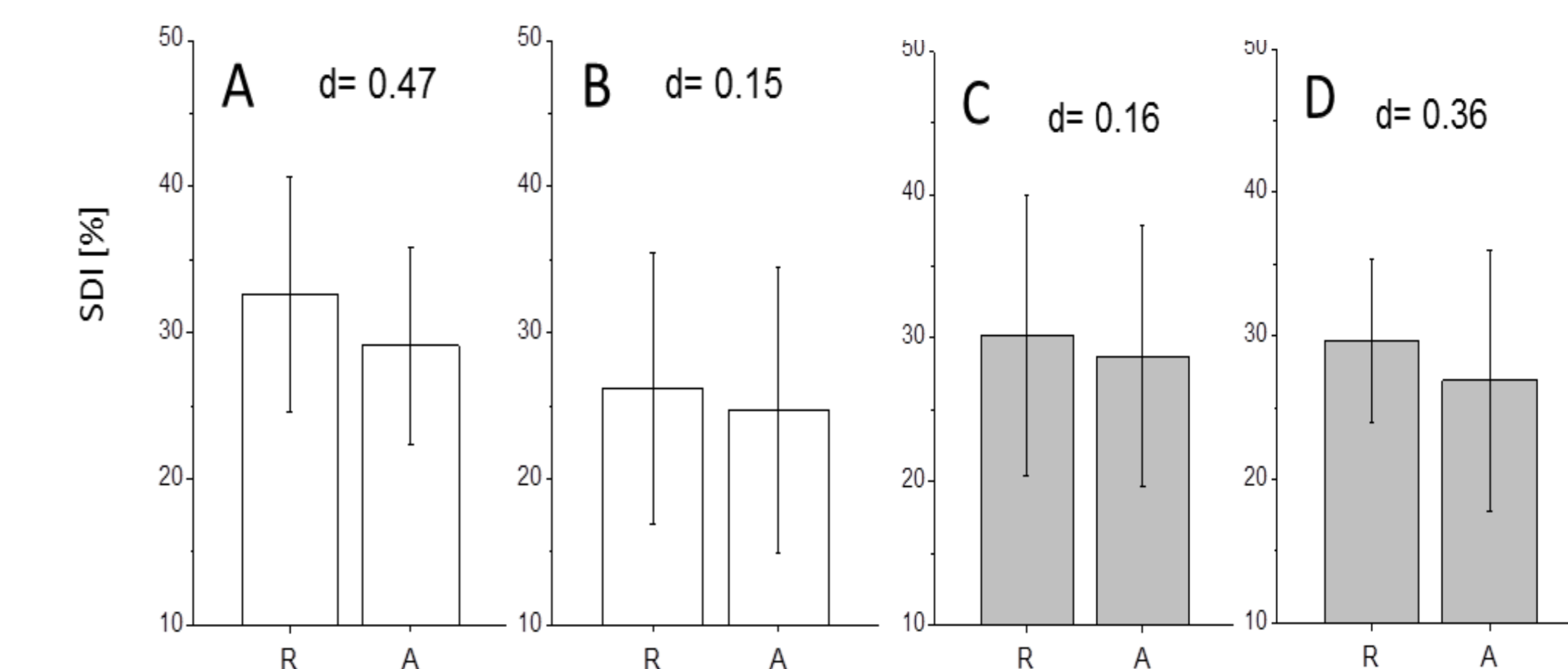


Figure 2 Strength Decrement Index (SDI) for recreational (R) and ambitious (A) climbers during upper grip positions on the left (A) and right (B) side as well as the lower position left (C) and right (D). (group x side interaction: $p=0.32$)

- side x position x time x group interaction for isometric grip strength ($p = 0.009$, $\eta_p^2=0.71$) → no post hoc differences (Fig. 1)
- maximal strength differences between left and right and group ($p<0.001$) : ambitious (left: 55 ± 8 kg vs. right: 62 ± 9 , $p=0.01$); recreation group (left: 47 ± 8 vs. right: 51 ± 9 , $p=0.04$)
- group difference for heart rates for bottom right (AC, pre: 91 ± 19 to post: 106 ± 24 ; RC, pre: 91 ± 21 to post: 124 ± 32)
- inverse correlation between asymmetry level and climbing level in AC (-0.70)

Conclusion & References

- grip strength decline did not relevantly differ between ambitious and recreational climbers
- Side-difference for RC and AC for maximal strength
- Asymmetry level and climbing level are interrelated

Donath L, Roesner K, Schöffl V, Gabriel HH. Work-relief ratios and imbalances of load application in sport climbing: Another link to overuse-induced injuries? *Scandinavian journal of medicine & science in sports.* 2011.

Quaine F, Martin L. A biomechanical study of equilibrium in sport rock climbing. *Gait & posture.* 1999; 10: 233-239.

Watts P, Newbury V, Sulentic J. Acute changes in handgrip strength, endurance, and blood lactate with sustained sport rock climbing. *The Journal of sports medicine and physical fitness.* 1996; 36: 255-260.