Effect of Hypohydration on Climbing to Failure on a Treadwall

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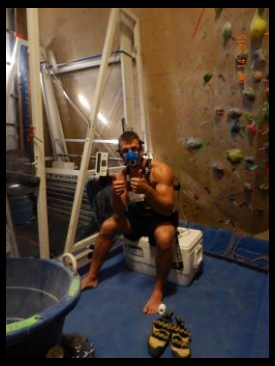
Purpose

- To examine the effect hypohydration had on climbing performance, determined by climbing time
- To examine the effect hypohydration had on mean VO_2, peak HR, SBP, and RPE

Methods



- 9 male climbers
- From north central Kentucky
  - and surrounding areas
- 1^{+} years of climbing experience
- 18-45 years of age
- Participated in 2 climbing session
- Randomly assigned hydration level for each session
  - 1^{st} session: euhydration, 2^{nd} session: hypohydration

    or
  - 1^{st} session: hypohydration, 2^{nd} session: Euhydration

Methods

- Climbing session outline:
  - Initial intake (1^{st} session only)
  - Urinalysis
    - Euhydrated state = $U_{sg} < 1.020$
    - Hypohydrated state = $U_{sg} \geq 1.020$
  - Rest and equipment preparation
  - Baseline measures
    - HR, BP, VO_2, RPE
  - 5 min warm up
  - Climbing session and measures
    - VO_2, HR, CT
  - Post climb measures.
    - BP, RPE

Methods

- Climbing procedure:
  - Treadwall:
    - Set at a 10° overhang
    - Same resistance for all climbs
  - Asked to climb to failure:
  - Climb time:
    - Start: climber was signaled to start
    - End: when climber stepped back on mat

Statistical Analysis

- 3 – Repeated measure T-tests
  - 2 conditions
    - Euhydrated
    - Hypohydrated
  - 3 variables
    - Time to complete the climb
    - Rate of perceived exertion
    - Mean VO_2
- 3 – Cohen's *d* effect size

Statistical Analysis

- 2 x 2 RM ANOVA
  - Dependent variables:
    - Heart rate
  - Repeated measures:
    - Hydration level
      - Euhydrated
      - Hypohydrated
    - Test occasions
      - Resting
      - Peak
- 2 x 2 RM ANOVA
  - Dependent variables:
    - Systolic blood pressure
  - Repeated measures:
    - Hydration level
      - Euhydrated
      - Hypohydrated
    - Test occasions
      - Resting
      - Post-climbing

Results

Variables	*M*	*SD*	Min	Max	*t*(8)	*p*	Cohen's *d*
VO_2							
Euhydrated	32.62	3.54	27.31	37.99	1.58	.15	0.53
Hypohydrated	30.99	2.99	28.47	36.13			
CT							
Euhydrated	780.22	981.72	136.00	3058.00	1.12	.30	0.37
Hypohydrated	680.67	755.30	161.00	2268.00			
RPE							
Euhydrated	16.00	2.29	13.0	19.00	0.31	.77	0.10
Hypohydrated	15.78	1.79	12.0	18.00			

VO2 = Volume of oxygen consumed (ml/min/kg)
CT = Climb time (seconds)
RPE = Rate of perceived exertion (Borg Scale)
Alpha level = .05

Descriptive Statistics for Hydration Level and Occasion for Heart Rate and Blood Pressure (N = 9)

Variables	Euhydrated		Hypohydrated	
	M	*SD*	*M*	*SD*
Heart Rate (bpm)				
Resting	63.67	10.40	63.67	11.09
Peak	174.22	8.83	170.89	10.89
Blood Pressure (Systolic – mmHg)				
Resting	126.89	6.86	123.44	10.06
Post	155.22	17.72	155.22	15.73

bpm = beats per minute
mmHg = millimeters of mercury

Results

	F(1,8)	*p*	η^2
Heart rate (bpm)			
Main effect hydration state	0.59	.47	.07
Main effect occasion	722.00	.00	.99
Interaction	0.94	.36	.11
Blood Pressure (Systolic – mmHg)			
Main effect hydration state	0.31	.59	.04
Main effect occasion	43.94	.00	.85
Interaction	0.50	.50	.06

bpm = beats per minute
mmHg = millimeters of mercury
Alpha level = .05

Discussion: Limitations

- Sample group
  - Small
  - Diverse
  - All data was included in the statistical analysis
- Hydration
  - 2 categories
- Use of a treadwall
  - Continual climb
  - Resistance
  - Mental state
- Skill level and climb rating
- Equipment issues

Descriptive Characteristics of the Subjects (N = 9)

Variables	M	SD	Min	Max
Age (yrs)	35.33	7.12	26.00	43.00
Height (cm)	178.00	6.20	171.00	190.00
Weight - E (kg)	71.00	5.60	62.00	79.00
Weight - H (kg)	70.56	6.58	61.00	80.00
BMI (kg/m2)	22.34	1.71	20.80	26.06
Experience (yrs)	10.94	6.36	1.50	22.00

E = Euhydrated
H = Hypohydrated

Discussion: Statistics

- Effect Size:
  - Climb time: *d* = .37
    - **Euhydrated: 780.22** ± 981.72
    - Hypohydrated: 680.67 ± 755.30 s
  - Mean VO2: *d* = .53
    - **Euhydrated: 32.62** ± 3.54
    - Hypohydrated: 30.99 ± 2.99 ml/min/kg
  - Implies:
    - Hypohydration had a negative impact on CT and VO_2
    - Impact was not statistically significant due to the small sample size

Discussion: Previous Research

- No current studies published examining hydration and climb time
- In a review of literature, Judelson et al. (2007) reports:
  - Hypohydration to have a negative impact on endurance performance
  - that some studies (while not as widely supported) reported a significant decrease in non-oxidative performance

Discussion: Previous Research

- Conder, B. J. (2011)
  - Significant decrease in %BW and %PV during the climbing trial
  - Decrease in cardiovascular stress when water was given ad libitum
- In a meta-analytic study, Gigou et al. (2010) reports:
  - A decrease in exercise performance when subjects were in a hypohydrated state versus a euhydrated state
  - A lower VO2 max in hypohydrated subjects than euhydrated subjects,
    - with a greater loss in subjects who had a decrease in body weight greater than 4%

Discussion: Importance

- Although not significant, subjects tended to climb longer and at a higher VO_2 level when euhydrated compared to hypohydrated
  - Similar to previous hydration studies
- Important for training and competition
  - Important to understand all factors of performance
- Provides a starting point for future research

Discussion: Future Research

- Suggestions for future research on climbing performance:
  - Hydration
    - Set a specific level
    - Chronic vs acute hypohydration
  - Use an actual wall
    - Indoors or outdoors
  - Mental state of the climber
  - Specific skill level of the climber
  - Rating of the climb

Conclusion

- Rock climbing is a growing area of interest
  - Research is becoming more prevalent
  - The number of climbers and competitions are increasing
  - The limits of the sport of rock climbing are continually being pushed
- It is important to understand all the factors of climbing performance
- This study is the beginning of understanding hydrations role in climbing performance

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Methods

- Protocol for both sessions:
  - Abstain from caffeine for 24 hours prior
  - Abstain from alcohol for 24 hours prior
  - Abstain from food for 3 hours prior
  - Abstain from strenuous activity for 48 hours prior
- Protocol for euhydrated session:
  - Consume 500ml of water before bed
  - Consume at least 250ml of water upon waking
- Protocol for hypohydrated session:
  - Consume no fluids after 8pm the night before