Weight Cutting in Mixed Martial Arts: The Cognitive and Physical Consequences of Pre-Competition Rapid Weight Loss

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INTRODUCTION

- Mixed martial arts is a relatively new sport that places unique demands on its athletes; yet it is not as well studied compared to other combative sports
- Mixed martial arts sport competitions separate athletes into weight classes
- To have a competitive size advantage athletes use rapid weight loss (weight cutting) to officially weigh-in 24 hours prior to an event at their weight classes upper limit and then return to normal weight prior to the event
- Weight cutting is the use of primarily dehydration (combined with diet and exercise) to reduce ones body mass by 5-10% in a short time period[3]
- Studies in different combative sports found that significant weight loss using dehydration increased the risk of muscle damage and decreased energy, cognition and physical performance[3]

PURPOSE

To examine the relation between weight loss using dehydration and cognition and strength prior to competition in mixed martial arts athletes

METHODS

Participants

A total of 60 amateur mixed martial arts athletes competing under the BC Athletic Commissioner Office rules (8 Female; 52 Male)

Procedure

Data were collected at 3 separate times and locations prior to events

- Not all participants completed testing at each time point

	Time-1	Time-2	Time-3
Time Until Event	10-14 Days	24 Hours	1-3 Hours
Testing Location	Gym	Official Weigh-in	Venue

Measurements

Cardiac Physiology – *Polar Heart Rate Monitor*

- Sit-to-Stand Max Heart Rate
  - Measure of sympathetic and parasympathetic activity

Weight – *Scale (Sensitive to 50g)*

- Body Mass (Kg)
  - Relative difference between test times is a measure of weight gain/loss magnitude

Strength – *Hydraulic Hand Dynamometer & Force Plates*

- Hand Grip Strength (Kg)
  - Index of upper body strength
- Vertical Jump
  - Index of lower body strength

Cognition

- King-Devick Test
  - Ringside concussion test based on cognitive processing time & error detection

Hydration – *U.S.G. Refractometer & Heart Rate Monitor*

- Sit-to-Stand Heart Rate Change
  - Index of hydration status[4]
  - Heart Rates were recorded while seated (2min) and after moving to standing (1min)
  - Sitting vs. Standing for 15, 30 & 60 seconds
- Urine Specific Gravity (mmol)
  - Measure of water concentration in urine
  - Relative difference between test times is a measure of water gain/loss magnitude

Statistics

- SPSS (v.24) was used for all analyses
- Within participants analysis was done using a General Linear Model
- Spearman's rho correlations were calculated between T1-T2 difference scores for Body Mass and Urine Specific Gravity and other variables

RESULTS

Relation Between Body Mass & U.S.G.

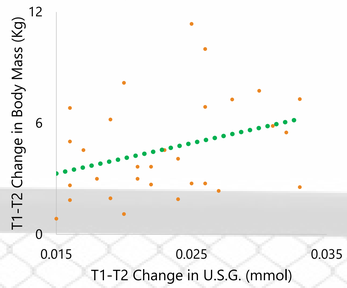

Table 1 – Mean *(SD)* for Body Mass & U.S.G. (n=21)

table 1		Time 1	Time 2	Time 3	F	p	Partial Eta²
Body Mass	(Kg)	74.44	70.77	74.07	50.71	0.00	0.72
	SD	(13.11)	(12.26)	(13.33)			
U.S.G.	(mmol)	1.01	1.03	1.01	299.00	0.00	0.94
	SD	(0.00)	(0.00)	(0.00)			

- Significant Spearman's rho correlations between difference scores for Body Mass (T1-T2) and U.S.G. (T1-T2) [$r_s(30)$= -0.405; p=0.03]

Relation Between Body Mass & KD Sum Time

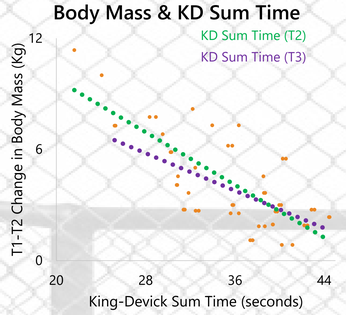

Table 2 – Mean *(SD)* for King-Devick Sum Time & Sum of Errors (n=21)

table 2		Time 1	Time 2	Time 3	F	p	Partial Eta²
KD Sum Time	(s)	41.39	36.53	36.42	29.09	0.00	0.59
	SD	(4.78)	(5.12)	(5.06)			
KD Sum Errors		0.00	11.81	4.33	21.79	0.00	0.52
	SD	(0.00)	(9.75)	(4.60)			

- Significant Spearman's rho correlations between difference scores for Body Mass (T1-T2) and King-Devick Sum Time (T2) [$r_s(30)$= -0.57; p=0.00]
- Significant Spearman's rho correlations between difference scores for Body Mass (T1-T2) and King-Devick Sum Time (T3) [$r_s(21)$= -0.49; p=0.03]

Relation Between Body Mass & Max HR

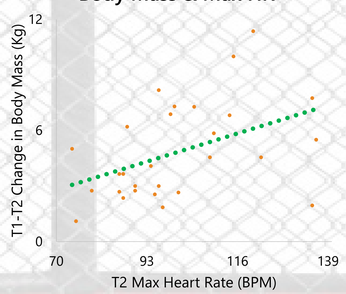

Table 3 – Mean *(SD)* for standing max HR & time max HR occurred (n=21)

table 3		Time 1	Time 2	Time 3	F	p	Partial Eta²
Max HR	(BPM)	96	102	95	0.54	0.56	0.03
	SD	(22)	(31)	(12)			
Max HR Time	(s)	74.29	93.24	85.95	2.42	0.11	0.11
	SD	(28.99)	(30.58)	(19.47)			

- Significant Spearman's rho correlations between difference scores for Body Mass (T1-T2) and Max HR (T2) [$r_s(30)$= 0.41; p=0.03]
- Significant Spearman's rho correlations between difference scores for Body Mass (T1-T2) and Max HR Time (T3) [$r_s(21)$= -0.49; p=0.03]

Relation Between Body Mass & Left Jump Force

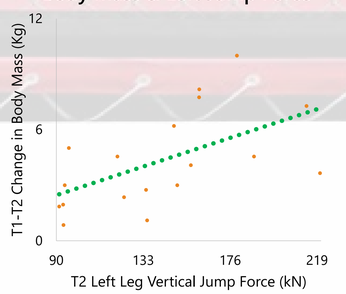

Table 4 – Mean *(SD)* for Vertical Jump Force (n=21)

table 4		Time 1	Time 2	Time 3	F	p	Partial Eta²
Jump Force Left	(kN)	161.39	142.16	157.15	6.07	0.02	0.46
	SD	(33.53)	(39.79)	(32.84)			
Jump Force Right	(kN)	152.35	154.84	151.61	0.02	0.97	0.00
	SD	(39.60)	(44.30)	(37.19)			

- Significant Spearman's rho correlations between difference scores for Body Mass (T1-T2) and Jump Force Left (T2) [$r_s(18)$= 0.59; p=0.01]
- Significant Spearman's rho correlations between difference scores for U.S.G. (T1-T2) and Jump Force Left (T2) [$r_s(18)$= -0.71; p=0.00]

Table 5 – Mean *(SD)* for Vertical Jump Time (n=21)

table 5		Time 1	Time 2	Time 3	F	P	Partial Eta²
Jump Time Left	(s)	0.53	0.49	0.51	1.03	0.36	0.13
	SD	(0.07)	(0.07)	(0.06)			
Jump Time Right	(s)	0.52	0.48	0.50	2.44	0.11	0.20
	SD	(0.06)	(0.09)	(0.07)			

Table 6 – Mean *(SD)* for Upper Body Strength (n=21)

table 6		Time 1	Time 2	Time 3	F	p	Partial Eta²
Grip Left	(Kg)	110.64	98.10	107.67	23.78	0.00	0.54
	SD	(27.20)	(24.93)	(25.60)			
Grip Right	(Kg)	111.74	99.74	110.29	17.91	0.00	0.47
	SD	(24.76)	(22.75)	(23.52)			

DISCUSSION

Weight and Hydration changes in participants

- Weight loss ($\bar{x}$= -4.93%) and Hydration status index changed from *hydrated* to *severely dehydrated*
  - Change in Body Mass (T1-T2) and U.S.G. (T1-T2) were significantly correlated indicating dehydration as the method of weight loss
  - Severe dehydration has been linked with cognitive and organ system dysfunction. Therefore, severe weight loss prior to an event could be considered an unsafe practice

Cognition changes in participants

- King-Devick Test Sum Time decreased and Sum of Errors increased
  - Change in Body Mass (T1-T2) and King-Devick Sum Time (T2) were significantly correlated and may indicate that weight cutting effects cognitive processing time
    - This may either reflect a change in brain function related to dehydration or a conscious decision in the athletes to sacrifice accuracy for speed
    - Further Study is required

Cardiac Physiology changes in participants

- Max Heart Rate decreased while Max Heart Time increased
  - Change in Body Mass (T1-T2) and Max Heart Rate (T2) were significantly correlated indicating that weight cutting may effect cardiac physiology.
  - Change in Body Mass (T1-T2) and Max Heart Rate Time (T3) were significantly correlated suggesting that changes in cardiac physiology from weight cutting persist 1-3 hours before an event

Strength changes in participants

- Jump Time, Left Jump Force and Grip Strength decreased; while Right Jump Force increased
  - Change in Body Mass (T1-T2) and U.S.G. (T1-T2) were both significantly correlated with Left Jump Force (T2) indicating that athletes relied more on their right leg after weight cutting. This difference could be related to athletes having a stronger preference to use their dominant leg when dehydrated
  - Muscle performance was significantly reduced at weigh-in (T2) and was likely associated with significant weight loss and dehydration

KEY FINDINGS

Mixed martial arts athletes showed significant weight loss and dehydration 24-hours prior to events. Weight loss and dehydration correlated with changes in strength, cognition and cardiac physiology. Athletes, coaches and physicians should be aware of the effects of significant weight loss and dehydration prior to events on athletic performance and general health

REFERENCES

[4]Cheuvront, S.N., Kenefick, R.W., & Charkoudian, N. (2012). Hydration assessment using the cardiovascular response to standing. *European Journal of Applied Physiology, 112*, 4081-4089.

[3]Pattersson, S., Ekstrom, M.P., & Berg, C.M. (2013). Practices of weight regulation among elite athletes in combat sports: a matter of mental advantage. *Journal of Athletic Training, 48*, 99-108.

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