THE EFFECT OF RAPID WEIGHT LOSS ON BODY COMPOSITION AND CIRCULATING MARKERS OF CREATINE METABOLISM IN JUDOKAS

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Abstract:

We evaluated the effects of a 7-day rapid weight loss (RWL) intervention on body composition and biomarkers of creatine metabolism in eight elite judokas during a pre-competition period. RWL induced a significant drop in weight (81.7±10.7 kg at baseline *vs.* 76.8 ± 10.3 kg at follow-up; $p<.001$), fat mass (12.6±5.6 kg *vs.* 9.2±4.0 kg; $p=.003$) and fat-free mass (69.1±7.3 kg *vs.* 67.6±7.7 kg; p=.05), accompanied by an increase in serum creatinine levels at follow-up (104.0±10.5 µmol/L *vs.* 114.9±10.2 µmol/L; p=.009). An acute restriction of food and fluid intake appears to negatively affect fat-free mass and indices of kidney function in judokas.

Key words: *rapid weight loss, fat-free mass, creatinine*

Introduction

Martial arts are weight-sensitive sports, with athletes often aiming to compete at the lightest weight class possible to gain physical advantages over smaller and weaker opponents (Khodae, Olewinski, Shadgan, & Kiningham, 2015). To accomplish this, many athletes tend to embrace different rapid weight loss (RWL) strategies to target specific weight within a period of ~ one week (Artioli, Gualano, Coelho, Benatti, Gailey, & Lancha, 2010; Reljic, Hässler, Jost, & Friedmann-Bette, 2013). The most frequently used RWL methods were dehydration and decreased energy intake (Artioli, et al., 2007), which were accompanied, as any RWL method usually is, by many adverse health effects (Sagayama, et al., 2014) and various biochemical, hematological and hormonal disturbances (Filaire, Maso, Degoutte, Jouanel, & Lac, 2010; Khodaee et al., 2015; Shimizu, et al., 2011). Specifically, a 7-day RWL negatively affects fat-free mass (Jlid, Maffulli, Elloumi, Moalla, & Paillard, 2013; Kons, Athayde, Follmer, & Detanico, 2017; Sagayama, et al., 2014) and might distress kidney function (Kanda, Muneyuki, Suwa, & Nakajima, 2015). In contrast with the plethora of papers focusing on boxing or wrestling (for a review, see Fogelholm, 1994), only few studies investigated the effects of RWL in judo athletes. No study simultaneously evaluated the effects of RWL on the body composition indices and circulating markers of creatine metabolism in judokas, including serum creatinine as a well-known indicator of renal function. Here, we evaluated the effects of a 7-day RWL intervention on body composition and biomarkers of creatine metabolism in elite judokas during a pre-competition period.

Methods

Eight male judokas (age 19.3±2.0 years, body height 178.1±6.3 cm, body weight 81.7±10.7 kg, professional experience 9.6±1.6 years) gave a written informed consent to participate in this study. The judokas were in weight categories ranging from under 66 kg to under 100 kg. All the athletes were free from cardio-metabolic diseases and musculoskeletal disorders, highly physically active (~ 15 hours per week), and did not take any medication or dietary supplementation.

The volunteers were assessed on two occasions separated by seven days. Strategy of weight loss included restriction of fluid and food intake and started seven days before the competition. During the first six days, dietary changes included restricted intake of fluids and macronutrients (total caloric intake reduced by 35%), followed by a total food restriction on the last day (a weigh-in day). Due to a lack of fluid intake, the competitors took vitamins and electrolytic supplements containing

no calories. The official weighing took place a day before the competition (roughly 15 hours before the competition started).

The study was conducted in accordance with the Declaration of Helsinki, with the study approved by the local IRB. In each assessment session, blood samples were drawn from the antecubital vein, with the blood serum separated, frozen and analyzed for creatine metabolites using modified LC-MS/MS (Agilent 1200 Series LC System, Agilent Technologies Inc., Santa Clara, CA, USA). The body composition parameters were measured using a multi-frequency body composition bioimpedance analyzer (BIA; MC-190, TANITA, Tokyo, Japan). When homogenous variances were verified for normally distributed data, the baseline *vs.* the follow-up measures were compared by a paired two-tailed Student's *t*-test. Wilcoxon signed ranks test for dependent samples was used to make the comparisons when non-homogenous variances were identified. Significance level was set at $p \leq .05$.

Results

The baseline and post-RWL characteristics of study participants are presented in Table 1.

The participants reduced their body mass by ~ 5 kg (95% confidence interval [CI] 6.4 kg to 16.2 kg) within seven days. Fat mass and fat-free mass were also significantly reduced after seven days of the RWL intervention ($p<.05$), while total body water was not affected during the study ($p>.05$). In addition, the serum creatinine levels were significantly increased at follow-up (mean difference 10.9 µmol/L, $p=.009$; 95% CI 0.2 µmol/L to 22.0 µmol/L), while serum creatine and guanidinoacetic acid were not affected during the study ($p>.05$).

Discussion

We found that a 7-day RWL intervention induced a significant drop in body weight, fat mass and fat-free mass in elite male judokas, accompanied by an increase in serum creatinine levels at follow-up. It appears that an acute restriction of food and fluid intake negatively affects fat-free mass and indices of kidney function in judokas. This is in line with previous studies, showing the effects of RWL on body composition in judokas. Artioli and co-workers (2010) reported that 822 male and female judokas lost up to 10% of their body mass in a one-week RWL intervention. Kons et al. (2017) reported a significant weight reduction following a 7-day RWL in 12 male judokas, although the total weight loss was half of the one in our study. Another similar study on judo athletes have shown that seven days of RWL induced a significant reduction in athletes' weight (from 74.4±9.0 kg at baseline to 70.0±8.8 kg at follow up), fat mass (from 13.1 ± 7.3 kg at baseline to 11.7 ± 7.5 kg at follow-up) and fat free mass (from 61.2±4.2 kg at baseline to 58.3±3.8 kg at follow-up) (Sagayama, et al., 2014). Similarly, Brito, Roas, Brito, Marins, Córdova, and Franchini (2012) reported a loss of ~ 5.6 kg in body weight (8.5%) during the last seven days prior to a competition in 145 judo athletes, achieved largely through an increase in physical activity, low-calorie diet and using sauna or plastic clothing. Total body water stayed fairly stable during the RWL protocol in the present study, which is somewhat surprising considering that fluid and carbohydrate restriction strategy was employed. A total body water reduction has been proved a main component in RWL protocols, with over 50% of the total weight loss attributed to a decline in total body water alone (Sagayama, et al., 2014). We can attribute results of the current study to measurement deficiency. O'Brien, Young, and Sawka (2002) found that the current BIA methods (both single and multi-frequency) are not sufficiently accurate to assess total body water under conditions of major hydration changes, with the equations developed in dehydrated populations not been shown to be valid for altered-hydration individuals. In addition, it has been suggested that assessment of water distribution volumes among athletes should use a phase-sensitive BIA instrument instead of volume estimations automatically calculated by the BIA device with the generalized regression equations (Moon, 2013). In addition, we find a significant increase in serum creatinine at follow-up (10.9 µmol/L on average), suggesting possible kidney stress after RWL in elite judokas. Serum creatinine is the most commonly used indicator of renal function, with higher levels (> 110 µmol/L) indicating disturbances in kidney function (Kanda, et al., 2015). Decreased tubular secretion of creatinine due to poor fluid intake (and excretion) might be a possible cause of elevated serum creatinine and a potential kidney stress after RWL, which requires further investigation. Nevertheless, a rise in serum creatinine is a late marker of

Table 1. Body composition and serum biomarkers of creatine metabolism at baseline and after rapid weight loss parameters in elite judokas (n=8). Values are mean±SD

	Baseline	Follow-up	p
Body composition			
Body mass (kg)	81.7 ± 10.7	76.8 ± 10.3	0.000
Body fat (%)	15.1 ± 5.3	11.8 ± 3.8	0.005
Body fat mass (kg)	12.6 ± 5.6	9.2 ± 4.0	0.003
Fat-free mass (kg)	69.1 ± 7.3	67.6 ± 7.7	0.049
Total body water (kg)	50.3 ± 5.7	49.5 ± 5.6	0.281
Serum			
Creatine (µmol/L)	21.5 ± 7.7	20.0 ± 8.0	0.502
Creatinine (µmol/L)	104.0 ± 10.5	114.9 ± 10.2	0.009
Guanidinoacetic acid (µmol/L)	2.0 ± 0.3	1.9 ± 0.3	0.632

kidney damage, observed only with marked damage to functioning nephrons (Samra & Abcar, 2012). To evaluate the possible RWL-induced kidney stress, other markers of kidney damage are highly warranted for future studies, including neutrophil gelatinase-associated lipocalin, either urinary or plasmatic, kidney injury molecule, interleukin 18, N-acetyl-d-glucosaminidase, cystatin C, tissue inhibitor of metalloproteinases, and insulin-like growth factor-binding protein 7.

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