



## METHODS AND MAGNITUDES OF RAPID WEIGHT LOSS IN JUDO ATHLETES OVER PRE-COMPETITION PERIODS

original paper

doi: 10.1515/humo-2017-0014

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### ABSTRACT

**Purpose.** The study aimed to analyse the methods and magnitudes of rapid weight loss (RWL) in judo team members in distinct periods before the biggest state competition in Southern Brazil.

**Methods.** Twelve male judo athletes took part in the study. The data collection was performed in three periods: (1) three months before the biggest state competition, (2) one week before the competition, (3) the day prior to the event. Anthropometric assessment and the Rapid Weight Loss Questionnaire were performed. Student's *t*-test and ANOVA were applied, with the significance level set at  $p < 0.05$ .

**Results.** The main results showed that the majority of athletes reduced  $7.1 \pm 6.8$  kg and started to lose weight to compete 13–16 years earlier. Increasing exercises (91.7%) and restricting fluid intake (41.7%) were the most frequent methods of weight loss. The judo coach/sensei was the person who most influenced the RWL procedure (58.3%). The athletes reduced 5% of their body weight ( $p < 0.01$ ), 2.4% of their body fat ( $p < 0.01$ ), and 2% of their fat-free mass ( $p = 0.04$ ).

**Conclusions.** We conclude that RWL was a common and premature practice in the athletes in the study. The most common methods were increasing exercise volume and restricting fluid and food intake. The coach/sensei was the most influential person in this practice. The judo athletes presented decreases in body fat and fat-free mass during the period prior to the competition.

**Key words:** combat sports, weight control, eating disorders, anthropometric measures

### Introduction

In general, participants of combat sports are organized by categories (e.g. by weight, age, or gender). Regarding body mass, judo presents seven divisions, ranging from < 60 kg to > 100 kg for males and < 48 kg to > 78 kg for females [1]. Placement in each weight category depends exclusively on the athletes' body mass. Thus, in order to reach a desirable weight class, several combat sportsmen (e.g. judokas) go through a rapid weight loss (RWL) process (2–10% of body weight reduction over 5–7 days) to, supposedly, obtain physical advantages [2]. According to the National Collegiate Athletic Association of Wrestling (NCAA), weekly weight loss should not exceed 1.5% of the individual's entire body weight [3].

One of the first studies regarding pre-competitive RWL among combat sportsmen demonstrated that wrestling athletes usually reduced weight by 5% of their total body weight a few days before the weigh-in [4]. Many strategies have been performed to achieve this goal, such as increasing exercise, restricting food and liquids

and using plastic suits [5, 6]. Nonetheless, some methods can be harmful to the athletes' health, mainly those associated with severe food and liquid restrictions [7, 8]. It was reported that high levels of dehydration and heat stress caused by RWL in the pre-competitive period had led to the deaths of three adolescent wrestlers [9].

Drastic body weight reduction before competition has been associated with physical performance impairment in judo athletes [8]. According to the authors, there are alterations in basal metabolism, muscular glycogen, aerobic capacity, cardiac output, and the immunological system. In addition, RWL may affect cognitive aspects, leading to disturbances in focusing and memory, as well as a lack of information processing [10]. Some studies have shown that athletes who regularly reduce their body weight (i.e. weight-cyclers) seem not to experience reduced performance following a proper recovery period [2, 11]. However, those studies only investigated weight-cycler athletes. Mendes et al. [12] found no significant differences in the impairment of performance (power output in the upper body) between weight-cycler and non-weight-

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Received: November 15, 2016

Accepted for publication: May 19, 2017

*Citation:* Kons RL, Da Silva Athayde MS, Follmer B, Detanico D. Methods and magnitudes of rapid weight loss in judo athletes over pre-competition periods. Hum Mov. 2017;18(2):49–55; doi: 10.1515/humo-2017-0014.

cyclist athletes. Both groups reduced 5% of their body weight in 5 days, indicating that chronic weight cycling did not protect athletes from the negative impact of RWL on performance. Moreover, discussions about this issue go beyond merely the physiological aspect, having a considerable impact on ethical and moral questions, since Artioli et al. [13] claim that the RWL strategy clearly violates the spirit of 'fair play', acting in contrast to sportsmanship.

On the basis of this point, it is important to analyse several variables throughout the body weight loss process because of the complexity of the physiological and psychological effects on the athletes' health and performance. Body composition measurements and the evaluation of the methods employed could help to develop strategies of gradual reduction during RWL, thereby helping to diminish the impairments and negative effects of RWL. To the best of our knowledge, there is no investigation that has transversely followed aspects concerning RWL in distinct periods before competition. Most studies have applied surveys to record the prevalence and methods in a single moment [5, 6, 14, 15]. Therefore, this study aimed to analyse the methods and magnitudes of RWL in a judo team during distinct periods before the biggest state competition in Southern Brazil. The main hypotheses were:

1. Judo athletes will reduce their body weight, body fat, and fat-free mass during the pre-competition period.
2. Fluid and food restriction will be the most frequently used methods for reducing body weight, especially on the day before the competition.

## Materials and methods

### Participants

The total of 12 male judo athletes took part in this retrospective study. The athletes were  $23.3 \pm 5.5$  years old and  $1.72 \pm 0.08$  m high, weighing  $87.21 \pm 0.84$  kg. They were active state/national level competitors, with technical graduation from purple to black belts (i.e. 3 purple, 7 brown, and 2 black belts), and a minimum of 7 years of experience in the modality. The athletes began their judo practice at the age of  $10.2 \pm 2.8$  years and were medallists at regional/state/national level competitions during the past two years. The criteria to join the sample were as follows:

1. Not presenting with any injury during the prior 3 months.
2. Minimum regular training practice of 3 judo sessions per week.
3. Age  $\geq 18$  years.
4. Not competing in the heavyweight category ( $> 100$  kg).

All participants were informed about the study procedures and signed the informed consent form in accordance with the Declaration of Helsinki. The study

was approved by the institutional Research Ethics Committee.

### Experimental design

The data collection was performed in three distinct periods: 3 months before the biggest state competition; 1 week before the same competition; and on the day prior to the competition. Anthropometric measurements and the Rapid Weight Loss Questionnaire (RWLQ) [16] were performed during the first assessment. The athletes were in a specific preparation period and began body weight reduction in that same week. During the second data collection (1 week prior to the competition), only body weight was measured. At the last evaluation (the day before the event), anthropometric measurements were performed again to obtain the fat-free mass, body fat, and body weight. In addition, the athletes answered questions similar to the RWLQ to describe the methods utilized for RWL in that specific pre-competition period.

### Anthropometric measurements

Body weight and height were measured with scales (Plenna<sup>®</sup>, São Paulo, Brazil) with the precision of 0.1 kg and a stadiometer with the precision of 1 mm, respectively. Four body skinfolds were assessed (triceps, subscapular, suprailiac, and median calf) with the use of a caliper (Cescorf<sup>®</sup>, Porto Alegre, Brazil) with 1 mm precision. Body density and body fat were estimated with Petroski and Pires-Neto [17] and Siri [18] equations, respectively. Fat-free mass (kg) was calculated as follows: absolute body mass (kg) – estimated absolute body fat mass (kg).

### The Rapid Weight Loss Questionnaire

The RWLQ, developed by Artioli et al. [16], was used to assess information about the magnitudes and methods of body weight reduction in the judo athletes. The questionnaire is composed of questions regarding participation in judo competitions, athletic achievements, weight history, dietary patterns, the magnitude of weight loss and individuals (parents, teammates, coaches, experienced athletes, health professionals) who guided/influenced the weight loss process, and questions if and by what methods the athlete intentionally modified body weight. For the question concerning the influence of others, a Likert scale of 1–5, with 1 = no influence and 5 = great influence, was used. The RWLQ was previously validated, demonstrating a high validity index, as assessed by 10 specialists (restraint scale = 0.62), and high reproducibility for all questions (ICC  $> 0.90$ ) [16]. This practical tool has been frequently used with judo athletes and other combat sportsmen [5, 14, 19].

### Statistical analysis

The data were presented as means, standard deviations, and relative frequencies. The Shapiro-Wilk test confirmed the data normality. A Student's *t*-test for dependent samples and an ANOVA for repeated measures, followed by a Bonferroni's test, were performed to compare the anthropometric measurements among the pre-competitive periods. The level of significance was set at  $p < 0.05$ . All statistical analyses were performed with the Statistical Package for Social Sciences software (SPSS Inc. 21 v. 17.0, Chicago, USA).

### Results

According to the RWLQ results, all athletes in the present study regularly reduced body weight to compete. The average body weight reduction was  $8.7 \pm 4.0$  kg. From the non-competitive period to the first evaluation (3 months before the tournament), the athletes reported a  $7.1 \pm 6.8$  kg body weight reduction. The group used to lose  $3.5 \pm 2.5$  kg per competition. Figure 1 shows the time (days) to start the body weight reduction prior to the pre-competition.

Figure 2 shows the age at which the athletes began to cut weight. It was demonstrated that the majority of the athletes started to reduce their body weight at around 13–16 years of age. After the competition, the athletes used to recover  $2.6 \pm 2$  kg.

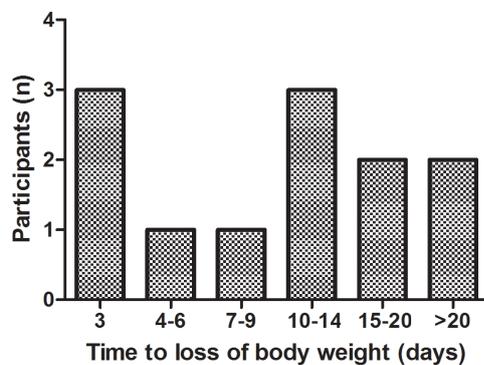


Figure 1. Time (days) to start body weight reduction prior to the pre-competition

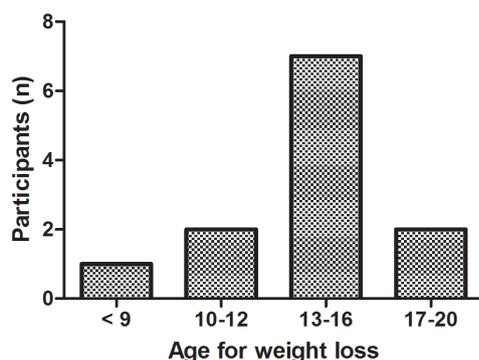


Figure 2. Age (years) at which the athletes began to cut weight

Table 1 shows the methods previously used by the athletes to reduce their body weight. The data were collected 3 months prior to the competition. Increasing exercise volume (above the usual amount) (91.7%), restriction of fluid ingestion (41.7%), and training intentionally in heated training rooms (33.3%) were most frequently marked as 'always'. Gradual dieting (50%) and skipping meals (41.7%) were cited as 'sometimes'.

The influence of other people on the athletes' weight management behaviours, as reported by the judo athletes, is illustrated in Table 2. These data were collected 3 months prior to the tournament, therefore they reflect the athletes' history. The influence of a judo coach/*sensei* was classified as 'somewhat influential' (58.3%) and 'very influential' (25%), while a dietitian (66.7%), physical trainer, and doctor (58.3%) did not represent any significance in the athletes' decision.

Table 3 shows the most frequently used methods for body weight reduction, assessed 1 day before the competition. Therefore, it contains the methods applied in the weight loss process for that specific tournament. According to the results, intake restrictions were the most pronounced methods, and within this category, the following were used: gradual dieting (21.2%), skipping one or two meals (15.2%), fasting (12.1%), and fluid ingestion restriction (12.1%).

The body composition data from the three assessments are presented in Table 4. There was a significant reduction in all anthropometric measurements (body weight, body fat, and fat-free mass) on the day before the competition. Body weight also presented significant decreases for the second evaluation as compared with the first one.

### Discussion

The present study aimed to analyse the body composition, as well as methods and magnitudes of RWL among a judo team in distinct periods before the biggest state competition in Southern Brazil. The main hypotheses were accepted, since the most frequently used methods for reducing body weight were food and fluid restrictions, especially on the day before the competition. In addition, there was a decline in body weight, body fat, and fat-free mass over the period of RWL.

The sample analysed in the study started the process of body weight reduction most often at the age of 13–16 years, and engaged in the weight loss process 10–20 days prior to the competition, which resulted in an average reduction of 7 kg. These findings are in accordance with a previous study on national level judo athletes [14], reporting an initiation of body weight reduction close to 12 years of age, with the weight reduction process beginning 8 days prior to the tournament. Another investigation found that the reduction behaviours commonly started at 17 years of age, with each process beginning approximately 14 days before

Table 1. Frequency analysis (%) of the most frequently used methods for body weight reduction, assessed 3 months before the competition

Method	Always (%)	Sometimes (%)	Almost never (%)	Never used (%)	I don't use anymore (%)
Gradual dieting	16.7	50.0	8.3	16.7	8.3
Skipping 1 or 2 meals	16.7	41.7	25.0	8.3	8.3
Fasting (not eating all day)	8.3	33.3	25.0	25.0	8.3
Restricting fluid ingestion	41.7	33.3	16.7	0.0	8.3
Increased exercises (more than usual)	91.7	0.0	0.0	0.0	8.3
Training intentionally in heated training rooms	33.3	33.3	16.7	8.3	8.3
Saunas	8.3	25.0	41.7	16.7	8.3
Training with rubber/plastic suits	6.0	33.3	8.3	0.0	8.3
Using winter or plastic suits during the whole day and night (without exercising)	8.3	16.7	8.3	58.3	8.3
Spitting	8.3	25.0	16.7	50.0	0.0
Laxatives	0.0	8.3	8.3	83.3	0.0
Diuretics	0.0	8.3	16.7	75.0	0.0
Vomiting	0.0	8.3	0.0	91.7	0.0

Table 2. Frequency analysis of the influence of other people on the athletes' weight management behaviours

Person	Not influential (%)	A little influential (%)	Unsure (%)	Somewhat influential (%)	Very influential (%)
Judo coach/ <i>sensei</i>	16.7	0.0	0.0	58.3	25
Fellow judoka	33.3	33.3	0.0	25	8.3
Physician/doctor	58.3	41.7	0.0	0.0	0.0
Parents	50	25	16.7	8.3	0.0
Dietitian	66.7	8.3	8.3	16.7	0.0
Physical trainer	58.3	25	8.3	0.0	8.3
Another judoka / training colleague	41.7	33.3	0.0	8.3	16.7

Table 3. Frequency analysis (%) of the most frequently used methods for body weight reduction, assessed 1 day before the competition

Methods	Frequency (%)
Gradual dieting	21.2
Skipping 1 or 2 meals	15.2
Fasting (not eating all day)	12.1
Restricting fluid ingestion	12.1
Training intentionally in heated training rooms	9.1
Increased exercises (more than usual)	9.1
Using winter or plastic suits during the whole day and night	9.1
Training with rubber/plastic suits	6.1
Saunas	3.0
Spitting	3.0

Table 4. Mean and standard deviation of anthropometric measurements obtained 3 months, 1 week, and 1 day before the competition

Anthropometric measurements	3 months	1 week	1 day	<i>p</i>
Body weight (kg)	87.21 ± 21.84	85.49 ± 22.3*†	82.92 ± 21.73†	< 0.01
Body fat (%)	14.76 ± 7.20	–	12.38 ± 6.52†	< 0.01
Fat-free mass (kg)	73.02 ± 12.38	–	71.49 ± 13.85†	0.04

\* significantly different from 1 day before the competition,

† significantly different from the '3 months' evaluation

the competition and resulting in an average weight loss of 8.5 kg [19]. Moreover, athletes of different ages reduced 2–11 kg in a 5-day period, with a greater loss observed in the juvenile and senior categories [20]. Athletes from other combat sports presented similar behaviours in the weight loss process. Brito et al. [19] reported that karate and taekwondo competitors initiated body weight reduction behaviours at around 13–14 years of age, although they reduced less weight (2–3 kg).

The premature practice of weight loss in teenagers may alter the nutritional state, leading to impairments in muscle mass development [21]. According to Thompson [22], a high incidence of eating disorders and the use of improper methods for weight loss indicate that young athletes may not be sufficiently meeting their nutrition and energetic demands. The same author reported the common practice of scarce carbohydrate intake by sportsmen participating in modalities that are divided by body weight, such as wrestlers. In addition, body weight reduction by dehydration is another issue, inducing harmful effects to the kidneys when performed regularly with such methods as increasing sweating, fluid restriction, and the use of diuretics drugs [9].

The methods regularly applied by the judo team (assessed 3 months before the competition) were increased exercises, the restriction of fluid ingestion and training intentionally in heated rooms. Gradual dieting and skipping meals were reported as ‘sometimes’ used. The day before the competition (i.e. concerning that specific pre-competition period), the athletes reported reduction of fluid and food intake (gradual dieting, skipping meals, and fasting). Although they increased their exercise volume, more aggressive methods (e.g. dehydration) were adopted as the competition approached.

Previous studies have investigated pre-competitive body weight reduction in combat sportsmen [5, 6, 15, 19, 20]. Artioli et al. [5] verified that increasing exercise volume, skipping meals, fluid restriction, and gradual dieting were the most frequently used methods among 822 judo athletes. Other investigations also proved that a hypocaloric diet, higher volume of exercises, and food restriction were the most often applied methods for body weight reduction among judo competitors [15, 20]. In wrestling [23, 24] and other combat sports [19], studies have found that increased exercise and food restriction were the primary strategies for body weight reduction.

Several methods reported by the athletes in this study can lead to health risks, such as dehydration and malnutrition. Dehydration may occur via transpiration increase, fluid restriction, and diuretic drugs. For example, sweating, when representing more than 5% of the total body weight, could result in severe health problems [25]. A previous investigation found a positive correlation between the dehydration level and cortisol concentration, whereas a negative correlation was observed between dehydration and total testosterone [7]. Filaire et al. [8] observed impairments in performance, differences in the nutri-

tional state (proteins and macronutrients), and increased aggressiveness after the RWL procedure. Malnutrition leads to body weight loss, since it reduces the glycogen stores, and may prejudice the performance [26], mainly in high intensity efforts, commonly associated with attack and defence actions in judo.

People who had a considerable influence on behaviours related to controlling weight loss were the judo coach/*sensei* and an experienced training colleague. Previous studies also reported the coach as having the greatest influence on weight loss in young judokas [14] and in adults competing at the national level [5]. Similar findings were observed in wrestlers, among whom the coach and training partners were the most influential [24]. The physical trainer was reported as being the major influence for athletes from different combat sports who engage in weight loss, followed by the head coach [19]. The high level of the coach’s influence seems to be predictable because he is normally the person closest to the athlete. However, this fact is worrisome, since the coach/*sensei* should know about the risks of the RWL process and encourage the athletes to manage a gradual body weight reduction. The lack of a professional career for many judo coaches in Brazil could explain this mismanagement. Facing this situation, orientation programs to spread information about the impairments and detriments of the RWL process could be provided for coaches, physical trainers, and athletes [13]. Furthermore, it is important to emphasize the need for a technical commission. The nutritionist and fitness coach should plan the diet, together with controlled physical exercise, since the athletes of the present study applied increasing exercises without professional supervision.

There was a significant reduction of body weight, body fat, and fat-free mass throughout the assessments (3 months and 1 day prior to the competition). Body weight was also measured 1 week before the tournament, and the results were different from the other two periods (i.e. there was a progressive decrease over the time). Thus, a significant weight loss was observed during the last few days prior to the competition, supported by the methods reported by the athletes (liquid and food restriction 1 day before the competition). The findings of the study showed body weight reduction of 5%, body fat reduction of 2.4%, and 2% reduction in fat-free mass, considering the period from 3 months up to the day prior to the competition. A previous investigation [27] among wrestlers also reported significant decreases in body weight (7.2%), fat-free mass (7.3%), and caloric ingestion (55.1%) 7 days before the competition.

Despite the athletes’ decreases in the body fat, which was expected in this investigation, there was also fat-free mass reduction. Lower values of body fat and higher muscle mass, as well as greater arm and forearm circumferences were observed in elite judo athletes, as compared with non-elite players [28, 29]. These findings suggest that elite athletes have higher performance in strength

and power tasks, presenting a greater muscle cross-sectional area [28]. Thus, during the RWL procedure, the participants may have decreased their strength/power capacities, generating performance impairments. However, no strength or power tests were performed to confirm this hypothesis. The decrease of fat-free mass could be justified by the methods reported to reduce body weight, such as fluid and food restrictions and the increase of exercise volume without professional guidance. Finally, it should be emphasized that a limitation of this study was a small sample size, since we analysed only a specific judo team. Further studies involving larger sample sizes may allow analysing comparisons for gender and other categories.

### Conclusions

Considering the history of the observed RWL process, we conclude that this is a common and premature practice among the participants of the present study. The most frequently used methods were increasing exercise volume and restricting fluid and food intake. The coach/*sensei* was the most influential person for this practice. Moreover, on the day before the specific competition, the food and fluid restrictions were the most frequently reported methods. In addition, the judo athletes presented decreases in the body weight, body fat, and fat-free mass during the period prior to the competition, showing rapid weight loss over the last week.

The presented findings offer a warning to professional staff involved with combat sportsmen to ensure a proper and gradual strategy of body weight reduction during the competitive period. In this sense, it is necessary to determine a link between the athletes' diet and the exercise volume/intensity in specific and non-specific tasks.

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