

Rapid weight loss in the context of Ramadan observance: recommendations for judokas

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ABSTRACT: Judo is a weight-classified combat sport, and many athletes seek to compete at the lightest possible weight category to gain an advantage from competing against shorter/smaller, and supposedly weaker opponents. To achieve a desired weight, most judokas opt for rapid weight loss techniques. Short-duration maximal efforts are not greatly affected by "making weight", but prolonged and/or repeated exercise is significantly impaired. Negative effects on mood, ratings of perceived exertion, and cognitive function are also reported. Moreover, rapid weight loss reduces maximal cardiac output and glycogen stores, and impairs thermo-regulation. Limited empirical data suggest that Ramadan reduces judokas' performance, and this is likely to be exacerbated by attempts at rapid weight loss. Weight reduction during Ramadan tends to be counterproductive, and judokas who aim for a lower weight category are advised to attempt any desired reduction of body mass during the weeks leading up to Ramadan, rather than during the holy month.

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OVERVIEW

Two recent books have discussed the management of athletes who engage in either total fasting or the intermittent fast required by Ramadan observance [1, 2]. Specific articles have also examined the impact of such practices on fluid balance and physical performance [3-6]. However, there are few reports concerning judokas, and none of the published articles have addressed the specific issue of the contestant who is observing Ramadan and who decides to reduce his/her body mass in the period immediately prior to the weigh-in for a competition.

"Making weight" is a very common practice among judokas. Immediately prior to a competition, contestants are sorted into 7 sex-specific weight categories, with the objective of ensuring equitable matches in terms of muscular strength and leverage [7]. Unfortunately, many judokas engage in rapid weight loss for a few days before competition in order to compete in a lower weight category and thereby increase their chances of victory [7, 8]. The tactics used include reduced ingestion of liquid, use of saunas, wearing imperme-

able plastic blouses and suits to increase sweating, a reduced overall energy intake and/or fasting prior to the weigh-in, and a selective reduction in the intake of carbohydrate or fat [8]. Some competitors resort to more aggressive tactics, such as forced vomiting [9] and the ingestion of various appetite suppressants, laxatives and diuretics [8].

Previous research [10-12] has underlined the negative effects of rapid weight loss on athletic performance. Nevertheless, many competitors persist with this practice prior to major competitions, endeavouring to achieve their weight goals quickly and avoid extended periods of fatigue [13]. Attempts to modify body mass probably influence several dimensions of affect, reducing anxiety and doubt, and increasing self-confidence and self-esteem. There may be other positive consequences: motivational (e.g., the perception of gaining an advantage over an opponent, and having greater control over the course of combat), cognitive (e.g., warding off negative thoughts, and increasing concentration on the upcoming event), and social

(e.g., enhancing a feeling of belonging to the culture of the sport, and perceiving oneself as being a professional athlete) [14].

Immediately after the weigh-in, judokas who have followed rapid weight loss methods try to correct their fluid deficit in preparation for combat. However, the opportunity to re-feed and rehydrate is usually lost during Ramadan observance, since this requires total abstinence from food and fluid intake between dawn and sunset during a period of 29 to 30 days. As the Islamic calendar has a lunar basis, Ramadan can occur at any time during the year. In summer and at high altitudes, it presents much greater challenges than during its observance in winter at lower altitudes. In temperate regions during the summer months, sunrise and sunset can be separated by 18 hours, or even longer in countries located close to the poles [15]. Ramadan inevitably coincides with many major sporting events. For instance, the London Summer Olympics of 2012 were scheduled during Ramadan. About 25% of the participants came from Muslim-majority countries, although it is less clear how large a proportion of these individuals observed Ramadan [16]. Those who did so would have consumed increased quantities of food and drink during the hours of darkness, largely meeting their fluid and nutrient needs [1, 2, 17]. However, there has been little possibility of such adaptation for the judoka who is attempting to “make weight”, at least until the change of timing of the weigh-in instituted by the International Judo Federation in 2013.

This brief review thus examines the practice of “making weight” with specific references to judokas and the observance of Ramadan. An initial search of PubMed and Google Scholar using the terms “rapid weight loss” and “judo” has been extensively supplemented from the reference lists of articles thus identified and from personal files. The text first considers the tactics adopted by judokas in “making weight”, the prevalence of this practice, its impact on competitive performance, and its interaction with the tapering of training. It then looks at how Ramadan observance impairs the competitive performance of the judoka, and how adverse effects are exacerbated by simultaneous attempts at “making weight”.

Precompetitive rapid weight loss in judokas

Judokas compete in categories based on their body mass in order to match athletes for body and size to limit the risk of injury [8]. There are 7 categories for both senior male and senior female contestants: <60 kg, <66 kg, <73 kg, <81 kg, <90 kg, <100 kg, and ≥ 100 kg; and: <48 kg, <52 kg, <57 kg, <63 kg, <70 kg, <78 kg, and ≥ 78 kg, respectively. The weigh-in for international judo competitions was traditionally performed in the morning, about 2 hours before the start of the first combat. Some authors have suggested that the adoption of a very brief interval, perhaps as little as one hour, between the weigh-in and the competition would discourage precompetitive weight loss [18]. However, from the Paris Grand Slam of 2013 until the Rio 2016 World Championship, the International Judo Federation decided that the weigh-in should be performed at 7.00 p.m. on the day before the competition. This longer interval

offers a greater opportunity to rehydrate and recover before the first combat, particularly for those observing Ramadan.

Some athletes have reportedly used artificial rehydration techniques such as the intravenous infusion of saline solution [18]. However, the World Anti-Doping Agency lists saline solution as a diuretic masking agent and as one of the “Substances Prohibited At All Times”.

Tactics of rapid weight loss and their prevalence in judokas

Athletes have resorted to a wide variety of tactics in order to achieve their target weight during the week preceding the weigh-in [19, 20]. Possible approaches have included a reduction of food and fluid intake, exercising in impermeable plastic blouses and suits to increase sweating, and passive dehydration (sitting in a sauna) [8, 21]. Often, endurance exercise is added to the usual training sessions; this supplementary exercise reduces body mass, but the need to increase training volume/load negates efforts at tapering, and it may result in fatigue, overreaching, or overtraining, with negative effects on mood and physical performance [22]. More aggressive and prohibited tactics include self-induced vomiting and the use of diuretics, laxatives, and anorexic medication [8, 19].

Artioli *et al.* [19] explored the prevalence and patterns of rapid weight loss in a group of male and female judokas, using the Portuguese version of the Rapid Weight Loss Questionnaire (RWLQ) [23]. Even when including athletes in the heavyweight class, 85.8% of men and 85.9% of women had lost body mass in order to compete. When heavyweight competitors were excluded from the analysis, the prevalence of rapid weight loss rose to 89%. A typical loss was 5% of body mass, but some athletes reported losing 5-10%, or even more. In the week following the competition, half of competitors regained up to 1.5 kg, ~40% regained up to 3 kg, and ~10% regained >3 kg. Most of the group had reduced their weight up to 5 times a year, but a significant percentage had done so 10 or more times a year. Moreover, the judokas generally began this practice very early in their lives and competitive careers.

The weight loss techniques reported were a combination of hypohydration (e.g., restricted fluid ingestion, or training while wearing a plastic or rubberized suit under the judo uniform), increased exercise, and/or decreased food intake. Those exerting the greatest influence on the athlete’s weight loss behaviour were coaches and fellow judokas; dieticians, physicians, and parents often had little or no influence. Athletes who had already switched to a heavier weight class scored significantly higher on the RWLQ compared to those who had remained in the same weight category. Surprisingly, male and female athletes showed no difference in RWLQ scores. State-, national-, and particularly international-level competitors had higher RWLQ scores than regional competitors. This could reflect not only the greater intensity of the competition, but also the greater number of competitions undertaken by high-level competitors. Higher scores were also seen among athletes who started weight-cutting procedures at a young age. However, there were no significant

differences in the prevalence of weight reduction between the different weight classes.

Brito et al. [24] examined the weight loss tactics adopted by participants in a number of combat sports (jujitsu, judo, karate, and taekwondo), using a standardized questionnaire. The judokas in this sample showed a significantly larger precompetitive body mass loss than those involved in other combat sports (the losses averaged 10, 8, 5, and 6 kg for judo, jujitsu, karate, and taekwondo, respectively). The judokas (87 regional-, 48 national-, and 10 international-level competitors) had begun reducing body mass at 17.0 ± 2.5 years, after 5.3 ± 0.5 years of involvement in the sport. The prevalence was substantially lower than that in the survey of Artioli et al. [19], with 62.8% of judokas reporting rapid weight loss before a competition. Tactics seen in this sample included an increase in activities (97%), dietary restriction (68%), carbohydrate restriction (33%), fat restriction (17%), fluid restriction (23%), use of a sauna and/or impermeable plastic clothing (44%), and the ingestion of diuretics or laxatives (13%). Judokas reported starting weight loss 14.5 ± 6.0 days before a competition, losing an average of 5.6 ± 2.2 kg ($8.5 \pm 4.2\%$ of body mass). Their main sources of information on methods of reducing body mass were fitness instructors (75%) and coaches (55%); other sources were magazines (44%), friends (41%), doctors (39%), parents (40%), books (33%), nutritionists (28%), and school physical education teachers (20%).

Weight losses generally depend on the level of competition. Judokas usually cannot maintain the same weight category over the course of their career, as weight is regained after a competition. By way of example, as a 23-year old, the Tunisian contestant Anis Lounifi won a gold medal in the <60 kg category during the 2001 World Championship. However, in the Tunisian Championship of the same year, he had won the title in the <66 kg category. He progressively lost ~7 kg of body mass during the 4 months separating the two competitions. For the entire 2001 to 2003 period, he competed in the <66 kg category. During the 2003 World Championship, he won a bronze medal in the <60 kg category, and in preparation for that competition, he lost more than 8 kg. He maintained a high level of fitness ($\dot{V}O_{2\max}$: $66 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$, $v\dot{V}O_{2\max}$: $21 \text{ km} \cdot \text{h}^{-1}$, % body fat: 5%), but failed to win a medal in the 2004 Olympic Games. He attributed this failure to the fact that 5 months before the 2004 Olympics, he reached a body mass of 70 kg, and he thus had to lose ~10 kg in order to participate in the <60 kg category. When interviewed for the present study, he stated "*In the 2003 World Championship, although cutting weight induced a reduction in my physical capacities, I was able to compensate for it not only because I was taller than my opponents in the <60 kg category, but also because I had technical and morphological advantages. However, in 2004, my percentage body fat was less than 5%, so I had to cut weight at the expense of my lean mass. Thus, I underperformed, feeling exhausted, dehydrated, and powerless. Unfortunately, those Olympic Games were won by a Japanese judoka that I had beaten in Japan about 10 months earlier.*"

Effects of rapid weight loss on the performance of judokas

Few studies have focused on the consequences of undertaking rapid weight loss a few days before a competition, and unfortunately the available research findings lack consistency. Discrepancies could reflect the timing of weight reduction, the recovery time available after the weigh-in, and the type of diet adopted during weight reduction [8] and/or the recovery process.

Garthe et al. [13] investigated the effects of rapid vs. slow weight loss. Thirty male and female elite athletes practising a wide variety of sports (football, volleyball, cross-country skiing, judo, jujitsu, taekwondo, waterskiing, motocross, cycling, track and field, kickboxing, gymnastics, alpine skiing, ski jumping, freestyle sports dancing, skating, biathlon, and ice hockey) were assigned to either a slow weight reduction group (SR) (8.5 ± 2.2 weeks) or a fast reduction group (FR) (5.3 ± 0.9 weeks), with reductions in energy intake of $19 \pm 2\%$ and $30 \pm 4\%$, respectively. Both groups undertook strength training (4 sessions/week) throughout the period of weight loss. Counter movement jump scores increased by $7 \pm 3\%$ in SR, whereas FR showed no significant change in this index. The 40-m sprint performance was unchanged in either group. The one-repetition-maximum (1-RM) squat improved similarly, by $11.9 \pm 3.4\%$ in SR and $8.9 \pm 2.3\%$ in FR. However, the bench-press performance increased more in SR than in FR ($13.6 \pm 1.1\%$ vs. $6.4 \pm 3.3\%$, respectively), and the bench-pull performance improved by $10.3 \pm 3.0\%$ in SR and $4.0 \pm 2.6\%$ in FR. The overall change in 1-RM for upper body exercises was also higher in SR than in FR ($11.4 \pm 2.6\%$ vs. $5.2 \pm 2.4\%$, respectively), and the weekly gains in all 1-RM measurements were $1.4 \pm 0.7\%$ and $1.3 \pm 0.5\%$ for SR and FR, respectively. On the basis of these observations, the authors concluded that athletes who want to gain 1-RM strength during a weight loss period combined with strength training should aim for a decrease in body mass of 0.7%/week, rather than 1.4%/week.

Clarys et al. [25] assigned 15 male and 7 female judokas to either a high weight reduction group (HWRG, $\geq 3\%$) or a low weight reduction group (LWRG, $< 3\%$). Both groups were tested before and after body mass reduction. Reaction times were unaffected for LWRG, but HWRG showed a decrease in reaction time on one of three tests. Isometric strength was unaffected in the LWRG, but was reduced in the HWRG. Anaerobic endurance, as assessed by 5 series of 20 maximal jump-squats interspersed with 1-minute rest, was unaffected in either group.

In another study, Artioli et al. [21] divided a small group of 14 experienced male judokas into a weight loss group ($4.8 \pm 1.1\%$ reduction of body mass over 5 days, followed by 4 hours of rehydration and re-feeding) and a control group. Evaluations were made before the 5-day weight loss period and after 4 hours of recovering from the weight reduction intervention. All subjects performed bouts of maximal-intensity *uchi-komi* exercise of 10-s, 20-s, and 30-s duration, interspersed with 10-s recovery periods; they then rested for 5 minutes before performing 5 minutes of judo combat. After 15 minutes of recovery, they next performed 3 bouts of a 30-s

upper-limb Wingate test interspersed with 3-minute recovery periods. Time structure patterns and the number of attacks made during judo combat did not differ between the 2 groups, and there were no significant inter-group differences in mean or peak power during the Wingate tests. Artioli et al. [21] thus concluded that rapid loss of 5% of body mass, followed by a 4-hour recovery period, did not impair simulated judo performance or arm power. However, judokas who were observing Ramadan would not always have a 4-hour opportunity to replenish their food and fluid deficit.

The studies cited above do not provide strong evidence that judo performance is impaired by rapid weight loss, although the experimental protocols adopted were less demanding than actual judo competitions. Despite a short duration bout (5 minutes, or up to 10 minutes with the golden-point process), the physical demands of a single judo contest are high, as can be inferred from physiological measurements (e.g., blood lactate) taken immediately following competition [26]. Moreover, in international competitions, finalists must perform 5 or more contests on the same day, with recovery times ranging from 10 minutes to a few hours. As yet, no study has investigated the effect of rapid weight loss on performance in actual judo combat, performed repeatedly on the same day.

Tapering of training and making weight

In order to optimize competitive performance, it is essential to plan tapering of training before a judo competition [27]. However, tapering and optimization of performance may be negatively affected by restriction of food and water intake in attempts to “make weight”. The final phase of training is generally based on high-intensity and low-volume exercises [28]. A gradual reduction in the training load allows the recovery of physiological capacities that were impaired by fatigue and restores the individual’s tolerance to training. For example, Papacosta et al. [27] reported that a 2-week taper after 2 weeks of intensified training significantly enhanced some aspects of physical performance in judokas; specifically, scores were improved for a 3 × 300-m run, a vertical jump test, and a left-hand grip strength test, although scores for a horizontal jump test, a Judo Fitness Test, a Multistage Fitness Test, and a right-hand grip strength test were unchanged [27]. Improvements in selected aspects of physical performance were accompanied by an increase in salivary testosterone/cortisol ratio and morning and evening salivary immunoglobulin A secretion rate, with a decrease in muscle soreness, and an enhanced mood state [27]. Nevertheless, performance optimization during tapering seems more the consequence of a significant reduction in accumulated fatigue than additional training-induced gains in fitness [28].

Ramadan fasting and rapid weight loss

Ramadan and competitive performance

During Ramadan, Muslims increase their intake of foods and fluids between sunset and dawn. This leads to several other behavioural changes. In particular, bed-time is delayed and sleep duration is

shortened (with less night sleep and more napping) as Muslims continue to eat late into the night [29].

Most investigators have found that these changes in sleep habits and the altered timing of food and fluid ingestion lead to some deterioration in athletic performance [6, 29]. However, the available data are somewhat conflicting. With regard to combat sports, there is no consensus concerning effects of Ramadan observance on performance. In 8 pencak silat athletes (a form of martial arts practised mainly in Indonesia), Tian et al. [30] showed that psychomotor function (processing speed), reaction time, vigilance (visual attention), visual learning and memory, executive function (working memory), and verbal learning and memory were all negatively affected by observance of Ramadan. In another study of 9 pencak silat competitors, Aziz et al. [31] reported significant decreases in the time to exhaustion when cycling at 60-80 rev·min⁻¹ against a load equal to 4% of the individual’s body mass, and in the total work performed during six 30-s Wingate tests interspersed with 4-minute rest intervals. These observations were made at 6:00 p.m. (shortly before *iftar*, or the sundown breaking of the Ramadan fast). Mirzaei et al. [32] noted that in 14 male collegiate wrestlers, maximal oxygen intake and mean power output achieved during six 35-m sprints interspersed with 10-s recovery intervals were lower during Ramadan than before Ramadan. In 12 male judokas, Aloui et al. [33] observed that the afternoon performance of squat jumps and counter movement jumps, maximal oxygen intake, and the number of *uchi-komi* undertaken during a Specific Judo Test were all negatively affected during Ramadan observance.

The performance decrements associated with Ramadan observance could be explained by several factors [1, 2], including disturbances of circadian rhythms [29], hypohydration [34], altered food intake [17], sleep disturbances [29], a decrease in training [16], alterations of body composition, and fatigue [16]. In a study of 15 male elite judokas, Chaouachi et al. [35] found that maximal oxygen intake and performances of the squat jump, counter movement jump, and 30-m sprints were all maintained throughout Ramadan observance; the only decrement of performance was in the mean power developed during repeated 30-s vertical jumping. Zarrouk et al. [36] also demonstrated in 8 karate players that the isometric maximal voluntary contraction, the isometric sub-maximal knee extension contraction, and the time to exhaustion of knee extension at 75% of maximal voluntary contraction were unimpaired by Ramadan observance.

The reasons underlying these discrepancies remain to be established. They could reflect differing periods of food and water deprivation, different performance test protocols, failure to allow for exacerbating factors [37], differences in the timing of experimental sessions, training status, the age and sex of the subjects, and environmental conditions. Most of the studies where Ramadan had no adverse effects on sport performance were conducted on athletes living in centres of excellence, where training load, sleeping schedule, and nutritional aspects were well controlled, and body mass was well maintained [16].

Some authors have suggested that where possible, training should be shifted to the beginning or the end of daylight during Ramadan, or simply concentrated during the evening when nutritional support can be provided [17]. However, such nocturnal rescheduling is not compatible with judo competitions, as finalists must perform up to 9 matches on the same day, with contests usually beginning in the morning and finals scheduled during the afternoon.

Some Muslim judokas have argued that if they are preparing for and competing at a high level, they cannot be expected to observe Ramadan dietary restrictions if they are to avoid injuries and continue to produce maximal effort. The Tunisian World Champion Anis Lounifi reported that if Ramadan fell during non-competitive periods, "he performed intense training sessions just before dawn (~4:00 a.m.) and technical and tactical training just before sunset." He maintained that "such management of training sessions is not possible in non-Muslim majority countries, and this may oblige Muslim judokas who must perform multiple high-intensity training sessions a day not to observe Ramadan fasting."

Rapid weight loss during Ramadan

Many factors make rapid weight loss a few days before competition a challenge during Ramadan. If an athlete undergoes rapid weight loss during this month, then the food and fluid deficit incurred during the diurnal fast cannot be restored adequately after sunset; the athlete is still striving to maintain a target weight, and must limit energy and fluid intake. Attempts at weight management during Ramadan may require eschewing the pre-dawn meal (*suhur*), thus increasing fluid, energy, and macronutrient deficits over the day, with significant impacts on fatigue and athletic performance.

The greatest challenge of rapid weight loss tactics during Ramadan is that it is usually impossible to restore the food and fluid deficit after a daytime weigh-in. Several studies have shown a decrease in short-term maximal performance after weight reduction when athletes were prohibited from re-feeding and rehydrating [38-40]. The negative effects of rapid weight loss have been linked to both severe acute dehydration [41] and depleted glycogen stores [42, 43]. Such effects are likely to be exacerbated in athletes who are observing Ramadan, since acute diurnal dehydration has been demonstrated during this month, even in those who are not attempting weight loss. Bouhlel et al. [44] and Aloui et al. [45] both noted increased haematocrit and haemoglobin values and a reduction in plasma volume during Ramadan observance. Other signs of hypohydration have included a reduction in urine volume, sodium, potassium, and total solute excretion and an increase in urinary osmolality [46, 47]. Other studies have shown a decrease in body mass during Ramadan [45], attributable to acute dehydration and/or decreases in fat-free mass, both being detrimental to performance [48]. The point at which water loss begins to affect performance is not well defined; but some investigators have suggested that the critical

depletion may be as little as 1-2% of body mass [48]. Hypohydration limits strength, power, and high-intensity endurance and has adverse effects on neuromuscular function and short-term power [49]. It may also impair short-term memory (affecting an athlete's ability to follow his/her coach's instructions before a competition [8]), vigour, concentration (limiting an athlete's ability to deal with distractions [8]), and self-esteem (reducing a competitor's confidence in victory [8]), while increasing confusion (limiting the capacity to make critical decisions [8]), rage (leading to lack of self-control [8]), fatigue, depression, and a sense of isolation (causing difficulty in coping with rigorous training sessions [8]) [40, 50]. Rapid weight loss can also have adverse effects on mood [51], ratings of perceived exertion [12], and cognitive function [43]. These parameters are crucial to success in judo, since this sport requires the attributes of concentration, judgment, and skill in addition to physical excellence [52]. Physiologically, rapid weight loss may decrease plasma volume, thus reducing maximal cardiac output, impairing thermo-regulation, reducing buffering capacity, depleting glycogen stores, and leading to hypoglycaemia and a progressive loss of body protein, electrolytes, and vitamins [10]. A combination of restricted fluid intake and water loss induced by sweating could reduce plasma volume by ~6% [11], thus impairing the performance of high-intensity exercise [53]. Muscle biopsies have demonstrated that rapid weight loss can decrease muscle glycogen concentrations by up to 54% [42].

Conclusion

Plainly, there is a need for more experimental research on performance changes in judokas and other combat athletes who engage in Ramadan observance in a well-managed environment. In particular, performance data are needed on individuals who also reduce their body mass by known amounts and at known rates, both before and during Ramadan. However, present evidence suggests that the potential negative effects of Ramadan observance on selected fitness and performance measures may put Muslim judokas at a competitive disadvantage. This is particularly likely if Ramadan observance is compounded by attempts at rapid weight loss. The best solution for Muslim judokas is probably to make any desired changes in body mass during the weeks leading up to Ramadan rather than during the holy month.

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