Review

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Elena Pocecco *, Friedemann Schneider, Pinelopi S. Stavrinou, Carl De Crée, Johannes Burtscher *

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Review

Fasting in Judo—Between Healthy Weight Control and Health Hazard: A Narrative Review

Elena Pocecco [1,*], Friedemann Schneider [2], Pinelopi S. Stavrinou [3] and Carl De Crée [4,5] and Johannes Burtscher [1,*]

[1] Department of Sport Science, University of Innsbruck, 6020 Innsbruck, Austria
[2] Department of Orthopaedics and Traumatology, Medical University of Innsbruck, 6020 Innsbruck, Austria
[3] Department of Life Sciences, University of Nicosia, Nicosia 2417, Cyprus
[4] Laboratory for Exercise Physiology and Endocrinology, Sports Medicine Research Laboratory, B-2800 Malines, Belgium
[5] Ghent University, B-9000 Ghent, Belgium
* Correspondence: to whom correspondence should be addressed: Johannes Burtscher, johannes.burtscher@uibk.ac.at , Elena Pocecco, elenapocecco@yahoo.it

Abstract: Rapid weight loss strategies (including fasting and dehydration) and weight cycling (losing and gaining weight repeatedly) are acknowledged problems in sports with weight categories, including judo. While extreme fasting, especially if combined with dehydration and intense physical activity, may harm health and development, particularly of children and teenagers engaging in judo competitions, there is substantial evidence for positive health effects of other forms of fasting. Here we aim to provide an updated overview on potential health risks associated with extreme dietary strategies in judo and put them in context with health-promoting fasting approaches. We conclude that the literature on long-term health consequences of fasting in judo is scarce. This applies specifically to the potential association with eating disorders. Many reports highlight short-term risks of rapid weight loss, however, vulnerability and protection factors remain poorly understood. Rigorous scientific studies are needed to disentangle the factors that render fasting in judo healthy or hazardous, considering long-term effects both for somatic and mental health. We argue that better understanding of weight management in judo may be used to prevent health risks for athletes and possibly also to propose novel weight management strategies to overweight individuals.

Keywords: judo; rapid weight loss; weight cycling; intermittent fasting; eating disorders; weight categories; martial arts; combat sports; weight management; diet

1. Introduction

Kodokan judo, commonly known as judo, is a martial art originating from Japan and conceptualized and promoted by its founder Jigoro Kano. It is based on two primary principles, (i) maximum efficient use of energy and (ii) mutual welfare and benefits [1]. Since World War II it has largely evolved towards becoming an Olympic combat sport and is now one of the most practiced combat sports worldwide [2]. Judo training often focuses on competitive purposes. However, an increasing number of practitioners value the diversity of judo training because of its health promoting potentials. This presented an important goal for Kano, who conceived judo as a means to promote physical, coordinative, intellectual, and educational development [2]. Other than the numerous benefits at the emotional, psychological, and social level [2], different benefits for the practitioners' physical health, including the skeletal system [3–6], appendicular muscle mass [3] and heart [7] have been attributed to regular judo practice. Judo practice also offers metabolic advantages, such as improved glucose and lipid metabolism [8]. Furthermore, some evidence suggests increased grey matter tissue density in some brain areas, including regions in the frontal, parietal and occipital lobes, compared to healthy controls in elite judo athletes [9]. Judo practitioners also had better postural and balance control compared not only to subjects not experienced in any sport involving equilibrium but even to dancers [10–12]. In addition, long-term judo training can modify lateral preferences,

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probably due to neuroplasticity [13]. Nevertheless, the vast majority of studies on judo relates to judo competition, whereas research on judo-training aiming to improve health and healthy aging remains scarce.

These potential health benefits contrast with the risks of competitive judo. A focus on competitive achievements and success may increase stress, promote the specialization on competition-centered techniques and training modes and increase the risk of injuries [2,14]. Furthermore, such focus may lead to unhealthy dietary habits, including substantial rapid weight loss, because of the desire to stay in or change towards a specific weight category. Whether and how these habits may relate to the development of eating disorders and other adverse developments or to potential benefits resulting from periods of fasting and strict weight control remain poorly investigated. Nevertheless, an awareness and knowledge on these aspects are crucial to avoid systematically adopting unhealthy dietary habits, or conversely to fully benefit from beneficial outcomes of periodic fasting that resembles types of "intermittent fasting". In intermittent fasting – per definition – the timing of eating is restricted and interspersed with short-term fasts with the aim of improving health, and specifically body composition and metabolism [15,16]. Different types of intermittent fasting currently receive great scientific interest, partly because they have been shown to reduce morbidity and mortality [17] and – in animal models – increase longevity [18]. In addition, intermittent fasting may be used to reduce body weight, theoretically without marked reductions of performance and with potential long-term benefits related to body composition and power [19]. Thus, forms of intermittent fasting may represent healthy (although slower than commonly applied methods for rapid weight loss) alternatives for weight control in judo. Regarding the prevention of detrimental outcomes of weight loss strategies in judo, the primary focus should be on the prevention of eating disorders, especially in the context of youth development and the loss of promising junior athletes due to fostering inappropriate lifestyles. Similar considerations apply to many sports other than judo, including many combat sports with weight categories, e.g., Brazilian jiu-jitsu [20], wrestling [21], taekwondo and karate [22] and a large number of other weight-sensitive sport disciplines (*inter alia*, because of direct weight requirements, aesthetics or advantages for endurance). For the latter increased eating disorders and disordered eating have been reported especially for female but also male athletes, for whom the consequences of unhealthy weight management strategies are even more poorly understood [23–25].

It is the purpose of this review to discuss the health-risks associated with fasting (rapid weight loss and chronic weight control), specifically, in competitive judo. Furthermore, we aim to highlight potential benefits related to health-promoting effects of (intermittent) fasting. We describe how applying new knowledge about fasting strategies may offer an answer to rapid weight loss, and we will discuss potential new options for overweight/obese people. We intend to offer suggestions to promote health by novel applications of intermittent fasting, both for athletes and non-athletes desiring to lose weight in a healthy way.

2. Metabolic and Cardiovascular Benefits of Judo

Regular physical activity offers well-established health benefits, in particular related to metabolism and the cardiovascular system. It also partially protects from many chronic diseases [26]. Martial arts practice, in particular, exerts potential beneficial effects on balance, cognitive function and psychological health [27]. Accordingly, regular judo practice appears to be associated with marked health benefits, including high physical fitness [28–30], improved heart structure and function corresponding to high aerobic and anaerobic performance [31] and positive psychological and social development in children and teenagers [2]. Judo's exceptional flexibility and modularity facilitates adaptation of judo practice for all age classes and adjusted to individual/specific needs [2]. This is important when determining appropriate levels of intensity and risks, especially when considering judo for recreational or health-promoting purposes.

Judo practice and competition requires that athletes, with relative short breaks between fighting phases and combats, repeatedly and quickly need to overcome the body mass and resistance of their opponents, both statically and dynamically. Elevated energy expenditure in competitive judo is

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reflected by high mean heart rates of around 85%–90% of maximal heart rates during judo contests [32,33]. Hence, judo is a sport with high demands on maximal and explosive strength, endurance and metabolism, in both the aerobic and anaerobic domains [31,34]. The anaerobic power and capacity of the upper body represent a determining factor for competitive success in judo [28,35]. Nevertheless, the oxidative system's contribution to energy metabolism (about 70%) is high throughout judo matches, when compared to the anaerobic glycolytic (8%) and ATP-Phosphocreatine systems (21%) contributions [34]. Still, a study that investigated energy metabolism requirements of judo competition, found that lactate levels had risen to a mean of 12.3 ± 1.8 mmol/l in venous blood samples obtained from 16 national judo athletes post-contest [36]. In addition, blood triglycerides, free fatty acids, and glycerol levels were significantly, but transiently, increased. Ammonia, hypoxanthine, xanthine, and urea levels showed similar increases [36]. These observations reflect a high reliance on protein and lipid metabolism during judo contests, which might be related to the metabolic stress, training adaptation and carbohydrate availability [36]. Consequences of pre-contest weight loss behaviors may contribute to these effects. Moreover, the specific biomechanical demands of judo have been suggested as important osteogenic stimuli, increasing bone metabolism and density [37]. An overview of metabolic and physiological demands is provided in Figure 1.

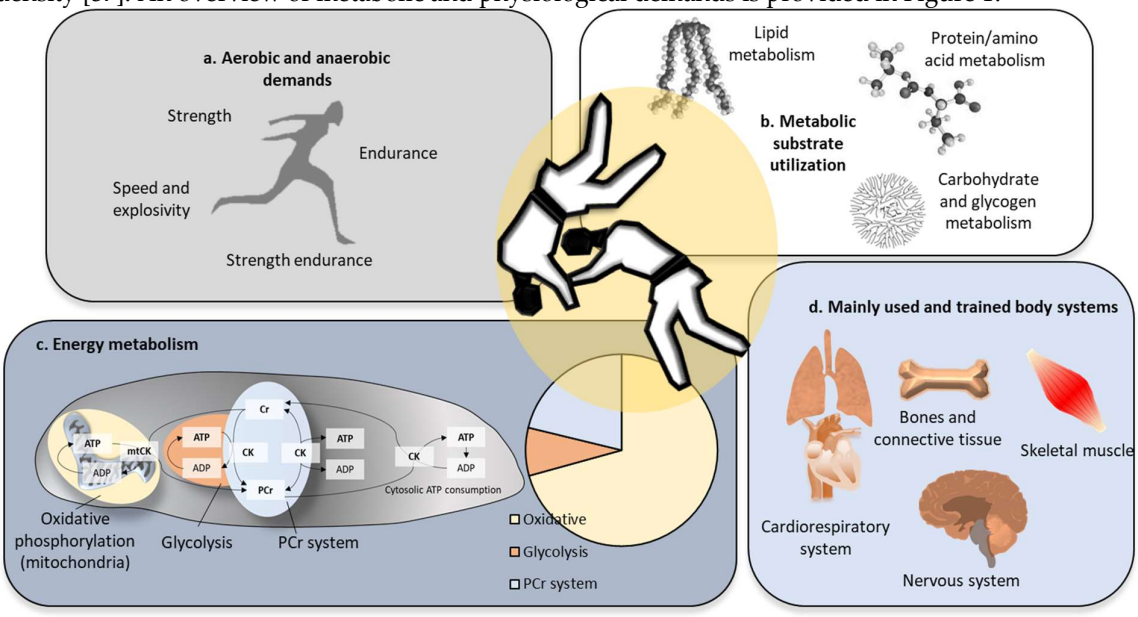

Figure 1. Specific metabolic and physiological demands of judo. ADP – adenosine diphosphate, ATP – adenosine triphosphate, CK – creatine kinase, Cr – creatine, mtCK – mitochondrial creatine kinase, PCr – Phosphocreatine.

In summary, high-level competitive judo athletes stand out by their dynamic strength, muscular endurance, and by both anaerobic and aerobic power and capacity [28,29]. The high metabolic and physiological demands may be linked to a potentially favorable utilization of diverse nutrients for energy metabolism [38]. This could represent an additional, specific health benefit of judo in relation to the applied dietary strategies but requires further elucidation.

3. Health Benefits of Fasting

Different types of fasting are used for various purposes. These include religious practices (e.g., Ramadan), sociological or health reasons (e.g., desired weight reduction or better body shape), or reasons related to competitive success in sports, such as to be admitted to a desired lower weight category [15,39]. Fasting may be based on caloric restriction or intermittent patterns of food consumption.

Intermittent fasting is used as an umbrella term for a variety of methods of short-term energy deprivation, with phases of fasting that often last several hours (usually 12 h or more). During these

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phases commonly only liquids such as water or unsweetened tea are consumed. These phases are alternated with periods in which food can be eaten with or without additional restrictions [15,40]. Well-designed forms of intermittent fasting have been shown to be beneficial in particular for cardiovascular and metabolic (e.g., lipid and glucose metabolism) health but in general have great, yet insufficiently explored, health potentials [16,41–43]. Rapid weight loss strategies and pronounced dehydration regularly applied by judo athletes (see section 4. Judo, unhealthy dietary strategies and eating disorders) are frequently associated with a compromised performance [44,45]. This may be reduced or prevented when using calibrated intermittent fasting approaches [19], or, when fasting periodically, such as during Ramadan, as long as training load and energy levels are monitored [46,47]. Intermittent fasting, as opposed to continuous energy restriction, includes different sub-types, such as time-restricted eating (TRE), in which the daily window for caloric intake is typically about 6-12 hours, short-term fasting and alternate day fasting. According to a recent network meta-analysis [39], among these approaches, alternate day fasting is the most efficient approach for short term (1-3 months) body weight reduction while TRE appears to be relatively more effective in reducing fasting glucose levels. Short-term fasting, with limitation in daily energy intake to about 25% for 2–3 consecutive or non-consecutive days of the week, led to the greatest short-term loss of body weight. These approaches are more effective when sustained over a longer period (>6 months) and less susceptible to weight regain effects that commonly occur in response to continuous energy restriction approaches after approximately 4 months. In this study, long-term TRE (7–12 months) proved to be the most effective strategy to achieve weight loss [39]. It might therefore, ultimately, be a valuable nutritional strategy to optimize body composition and maintain physical performance. These benefits may also apply to athletes aiming to reduce weight with limited loss of lean body mass and while maintaining performance and training intensity [19,48]. A recent umbrella review by Sun et al. [16] concluded that intermittent fasting is a potent tool to reduce waist circumference, fat mass, fasting insulin and systolic blood pressure, while permitting to increase fat-free mass and optimize lipid profile. In addition, intermittent fasting seems to benefit the gut microbiome by improving both richness and diversity of gut microbiota [49].

A few studies on judo athletes exist that looked into intermittent fasting in conjunction with Ramadan. During the month of Ramadan, athletes abstained from eating and drinking from sunrise to sunset according to the religious recommendations of Islam [47,50–53]. These athletes were able to maintain normal training loads. However, the results of these studies are inconsistent as far as performance is concerned [47,52,54]. In 15 elite junior judo athletes, Ramadan intermittent fasting substantially changed lipid profiles, haematological, inflammatory, and immunological outcomes, albeit that those values generally remained within normal reference ranges [50,51].

In conclusion, carefully executed types of intermittent fasting do not compromise performance, metabolism and general health. Rather, they represent efficient strategies for reducing body fat, while maintaining fat-free body mass or muscle mass, thus improving body composition. Overall, such dietary approaches represent opportunities to optimize weight loss and performance in sports with weight categories, such as judo. Importantly, there are considerable health risks when combining fasting with dehydration and physical exertion in order to achieve rapid weight loss [19,55,56].

4. Judo, Unhealthy Dietary Strategies and Eating Disorders

4.1. Rapid Weight Loss in Judo

Official (International Judo Federation, IJF) judo competitions for seniors (adults) are conducted in 7 female and 7 male weight categories. The lowest senior female weight category is -48 kg and the lowest male weight category is -60 kg. Senior female athletes heavier than 78 kg and male athletes heavier than 100 kg compete in weight categories without upper weight limit. Adapted weight categories exist for other age groups. Most competitively active judo athletes tend to reduce their body weight in just a few days immediately preceding competition with the purpose of remaining just under the upper limit of their weight category, in this way attempting to obtain competitive advantages over lighter adversaries [22,57,58]. They use either long-term or rapid weight loss

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practices for this purpose [59]. A similar organization in weight categories also exists in many other combat sports [45]. It has been estimated that about 60-90% of combat sports athletes [45] use methods for weight loss, such as intensive exercise, reduced fluid intake, fasting (including reduced carbohydrate/fat intake and not eating at all the day before weigh in), sauna, dedicated clothing, diuretics, laxatives and purgative behaviors/vomiting [21,60–63]. Rapid weight loss refers to such practices with the goal of losing weight (on average about 2-10% of the body weight) within approximately 1 week before a contest to compete in a lower weight class [60]. Judo athletes often start to use rapid weight loss strategies at an early age [45,64]. A study indicated that by the age of 13 years, 74% of the athletes engage in rapid weight loss practices before competitions [65]. Most athletes use rapid weight loss methods to reduce body weight by about 2-5% but many also occasionally lose 5-10% and some more than 10%, with more severe weight loss being more common in elite athletes [45,64,66]. Usually, the weight loss for a pre-competition weigh-in to compete in the lowest weight category possible, is followed by a post-competition weight regain. This means it is needed to decrease weight again for later competitions. Such patterns are called "weight cycling" [66,67]. While such practices may produce competitive advantages (competing in a lower weight category), they are also associated with health risks (see following section), for extreme approaches potentially even death as reported in the 90ies for 3 college wrestlers [68].

Nevertheless, the impact of rapid weight loss on performance is debated [69] and appropriate fasting strategies might even lead to metabolic and general health benefits, as discussed in section 3. In addition, the association between weight loss and competitive success is difficult to establish due to the many confounding variables involved [59]. In terms of physiological or overall performance, Štangar and colleagues surveyed 138 elite-level female and male judo athletes and found 96% of them applying rapid weight loss methods, with 91% reporting negative effects of these methods on their energy level, to the extent that 21% of them experienced a collapse period as result of their weight loss practices [70]. In addition, Fortes et al. showed that rapid weight loss resulted in lower performance in a judo fitness test and concluded that rapid weight loss should not be used for performance optimization in judo [58].

In summary, rapid weight loss strategies are commonly applied in competitive judo but how they affect performance remains poorly understood. In addition, severe forms of such approaches can pose threats to the athlete's health.

4.2. Health Risks of Rapid Weight Loss in Judo

Weight loss in judo and other sport disciplines is often performed too rapidly [22], likely without sufficiently adhering to nutritional guidelines. Such behaviors are associated with acute and chronic health risks [71]. In addition, Chapa et al. [25] in a meta-analysis showed that athletes participating in sports that have weight categories, such as judo, had higher levels of disordered eating.

An open question is whether weight loss habits in judo may promote unhealthy dietary behavior and possible even facilitate the development of eating disorders. Eating disorders have been reported to be more prevalent in sports with weight categories than in the general population or other sports as a consequence of such athletes' strong focus on weight [72–74]. Common eating disorders that are of relevance for athletes in weight-sensitive sports [23,25,75] include anorexia, bulimia and binge-eating disorders. People with anorexia nervosa dramatically restrict their food intake and/or apply purgative behaviors. Bulimia nervosa describes behaviors of food restrictions combined with compulsive binge-eating episodes and associated vomiting induction. Binge eating disorder is characterized by regular episodes of ingesting greater than normal amounts of food and perception of losing control over one's own eating behaviors [76]. The surprisingly small body of relevant literature on the topic of disordered eating or eating disorders in judo athletes is summarized below in the context of potentially adverse health consequences of rapid weight loss.

Rapid weight loss can cause diverse symptoms, including impairments in memory, concentration and vigor, but also feelings of confusion, rage, and depression and it can lead to fatigue [45]. Furthermore, perceptual motor-skill performance [77], decision making [78] and mood [79] of judo athletes may be negatively affected by rapid weight loss strategies. The acute health risks of

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rapid weight loss are mostly related to hypohydration, which generally can impair cardiovascular, cognitive and motor function [44]. Fluid restriction and 'sauna suits' remain an often-used tool for rapid weight reduction [70]. Accordingly, a prevalence of hypohydration in judo athletes of 89% in the morning of the competition day has been reported in a study [80]. Over 50% of these athletes were seriously hypo-hydrated at morning weigh-in [80]. Repeated dehydration in rapid weight loss has been associated with increased markers for acute kidney injury in wrestlers and thus may represent risk factors for the development of kidney injuries [60], although an actual connection remains to be confirmed. Also, impaired erythropoiesis and hormonal imbalances were reported to be induced by rapid weight loss in athletes of different combat sports [81,82]. The hormonal changes were characterized by a decrease in testosterone and triiodothyronine concentrations [81]. An increase in muscle damage markers has been observed following a combination of dietary restriction and intense exercise training for weight reduction before competition [83,84]. This suggests impaired muscular function and increased susceptibility of muscle tissue to injury [83,84].

Beyond those acute risks, some studies report potential psychopathological effects in response to rapid weight loss in judo athletes. Among those risks are the development of eating disorders, which may be increased as a consequence of repeated unhealthy rapid weight loss practices, particularly in women [85]. Rouveix and colleagues [86] found an overall low prevalence of manifest eating disorders in judo athletes using the Eating Attitudes Test (EAT-26). However, 25% of the tested female judo athletes (3 out of 12) were "at risk" for eating disorders according to this test. Furthermore, the corresponding EAT-26 scores of the female judo athletes were strongly correlated to body esteem [86]. These results were accompanied by a substantially higher occurrence of menstrual dysfunction in the female judo athletes (58.3%) as compared to female controls (7.1%) [86]. In another study rapid weight loss did not acutely affect the menstrual cycle but had negative consequences on development, e.g., reduced body growth, in juvenile female judo athletes [87].

Using also the EAT-26, Filaire and colleagues [88] observed a higher prevalence of disordered eating attitudes among the judo athletes (30% vs. 20% in controls) in a small questionnaire-based study in 20 judo athletes and 25 controls. These authors reported a significant positive correlation of disordered eating attitudes with body dissatisfaction and negative correlations with stress tolerance, emotional self-awareness and mood. Importantly, the EAT-26 has later been doubted to adequately reflect eating disorders in sports [22]. Escobar-Molina and co-authors [89] in an observational, descriptive study conducted in 144 Spanish judo athletes observed eating disorders and symptoms of anxiety, especially in young women. Beside the mentioned menstrual dysfunction, also risks related to bone health have been suggested to be associated with rapid weight loss in female judo athletes [90]. However, clear relationships remain to be established. Furthermore, judo training appears to be linked to improved bone metabolism and density, possibly counteracting potentially detrimental effects of rapid weight loss on bone health [37].

Long-term effects of rapid weight loss practices in combat sports have rarely been studied [91]. Maksimovic and colleagues recently found a higher prevalence of metabolic syndrome, a higher systolic and diastolic blood pressure, increased values of fasting blood glucose and trends of higher triglyceride levels in former elite combat sports athletes who had employed rapid weight loss strategies during their competitive careers, compared to former elite athletes from other sports, who did not [92]. They concluded that the first group of athletes is susceptible to negative metabolic alterations at the end of the competitive period [92]. The study's weight-category sports included judo, jujitsu, karate, kickboxing, taekwondo and boxing [92].

Taken together, rapid weight loss might compromise capacities that determine performance and increases the probability of injuries. However, long term outcomes of the dietary strategies associated with weight management in judo (including the potential modulation of eating disorder development) have rarely been investigated and remain largely unknown.

5. Discussion and Perspectives

Despite the well-recognized problem of unhealthy weight loss strategies in judo the literature on this topic is surprisingly scarce. Practical applications of scientific recommendations on this topic

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are largely lacking. Judo practitioners still frequently engage in unhealthy weight control behaviors. Consequently, they may suffer from somatic consequences of repeated rapid weight loss and weight cycling and from associated psychological pressure, similar to what has been reported for other weight-sensitive sports. Adverse outcomes may comprise injuries (e.g., kidney injuries due to dehydration), loss of talent because of the pressure to lose weight before competitions and the development of eating disorders. In the spirit of judo's primary principles (maximum efficient use of energy and mutual welfare/benefits) those problems need to be addressed. Maximum efficient use of energy should be applied not just in the application of judo techniques, but also in the context of maintaining a healthy body weight and applying responsible health management. In respect of the mutual welfare and benefits principle, it is essential that athletes are educated regarding healthy weight control and have access to the necessary support structure.

In contrast, many health benefits have been attributed to intermittent fasting strategies, ranging from prevention of chronic diseases to reduced mortality from many causes (see section 3).

Health risks of unhealthy dietary practices related to weight-category sports include the development of eating disorders, and in extreme cases already has led to lethal outcomes, e.g., in wrestlers [68]. To control and remedy extreme weight loss practices in judo – and combat sports in general – suggestions have included: banning weight-cutting altogether, tightening regulations with regard to weight loss practices, and reducing the gaps between the different weight classes [93]. Evidence supporting the effectiveness of such approaches is generally lacking [93]. Artioli et al. proposed an aggressive weight-management program that would require competitive judo athletes after weigh-in to pass a hydration test, and suggested imposing minimal permissible body fat limits in order to be allowed to compete [57]. Such strict regulations are difficult to impose and enforce. So, at the least, dietary consultation and early screening for eating disorder symptoms should be prioritized to prevent progression to severe eating disorders and other mental, physical and physiological consequences [67]. Early screening for eating disorders appears to be most crucial in young female athletes. However, although male athletes appear to have healthier coping strategies with stress linked to weight-reduction, it has to be emphasized that this topic is insufficiently explored. It should also be considered that children/teenagers who quit judo at young age might have taken this decision related to social/institutional pressure to engage in weight-loss practices. However, further research on how often that happens is necessary. The few available studies on inadequate weight loss practices indicate an important pedagogical necessity to improve knowledge and decision making in judo and other weight-category sports with regard to athletes' eating and fasting behaviors [57,87]. Such strategies include: organizing and emphasizing the importance of food and nutrition education, especially for young judo practitioners and those with specific medical conditions, as recently suggested [94] and the early detection of nutrient deficits via food consumption analysis. Role-model effects through educational programs involving successful active or retired elite athletes may be harnessed to increase awareness. Direct advise from those (former) athletes based on their own positive and negative experiences during their competitive careers could be used to communicate problematic dietary behaviors and point out solution strategies especially for young competitive judo athletes. Events enabling such exchange between young athletes and their role models has been shown to be highly appreciated by the participants [95]. Similarly, the discussion of fasting in weight-class sports should be an educational goal of dedicated influencers.

Rapid weight loss practices occur already among young judo practitioners, sometimes through pressure from parents [96] or institutions (e.g., clubs, including peers and coaches). Educational measures starting at an early age (for children, parents and coaches) are thus necessary to inform about health-consequences of extreme and/or repeated weight loss practices and to provide guidance for healthy weight control and long-term metabolic health [71]. Establishing minimum standards of qualification and experience for athletes, coaches and other staff members should be of high priority. Especially, when considering young competitors, it is important to promote a long-lasting career and healthy life, rather than early competitive success. The reorientation of performance goals towards achievement goals is important in a health-focused judo-practice context. [14].

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Considering the pronounced health potentials of well-designed fasting strategies (see section 3), a challenge for future research will be the modification of potentially hazardous weight-class-related weight-cycling into health-promoting fasting strategies. The exploration of the systematic use of potentially health- and performance-enhancing applications of (intermittent) fasting might lead to new avenues that harness healthy dietary strategies for weight loss in judo, and in weight-sensitive sports in general. In addition, they might include new efficient strategies to target obesity. There is a wealth of implicit knowledge on professional weight control in judo and other combat sports. It would appear wasteful to disregard all this knowledge and the motivation associated with competition-related body weight manipulation when exploring novel applications to efficiently counteract the spreading "obesity pandemic" [97]. The combination of exercise (for example judo) with calibrated weight management elements, seems to be a particularly promising approach to reduce overweight and obesity.

5.1. Conclusions

Previous research findings about protective strategies against unhealthy weight loss in judo have not yet found broad application. We concur that extreme weight loss approaches, in particular in young athletes, should be prohibited and sanctioned. However, considering the lack of implementation of such suggestions until now, educational measures may be more successful. Also, new, practical and feasible strategies need to be developed and implemented in order to provide support to athletes, who may wish to achieve slight to moderate loss of body weight in a healthy way, and avoid severe dehydration and the mental stress that often accompanies extreme weight loss goals. In addition, it may be possible to develop some of the (healthy) aspects of weight loss strategies used by judo players for addressing obesity in nonathletes.

5.2. Future Directions

Although the problem of unhealthy weight management in judo and other weight-category sports has been known for decades, the precise intersection between specific weight-loss strategies, weight cycling, and physical and mental health, remains insufficiently understood. For example, the association between such dietary strategies and the development of eating disorders has rarely been investigated. The available studies are mostly based on inadequate research tools, include too many confounding variables, or suffer from a poor research design. Therefore, a rigorous investigation of positive and negative outcomes of weight management strategies in judo and the identification of involved individual protective or vulnerability factors (coping strategies, personal eating habits, microbiome composition, medical conditions, etc.) is essential (Figure 2). In addition, a variety of measures including: educational strategies (dietary counseling of athletes, adequate formation of coaches and other stakeholders, role model/mentor/influencer approaches, etc.) should be proposed and implemented to raise awareness and enhance the competencies of the individuals involved in making health-promoting decisions. It is equally important to effectively reduce societal and institutional pressure to pursue unhealthy dietary strategies.

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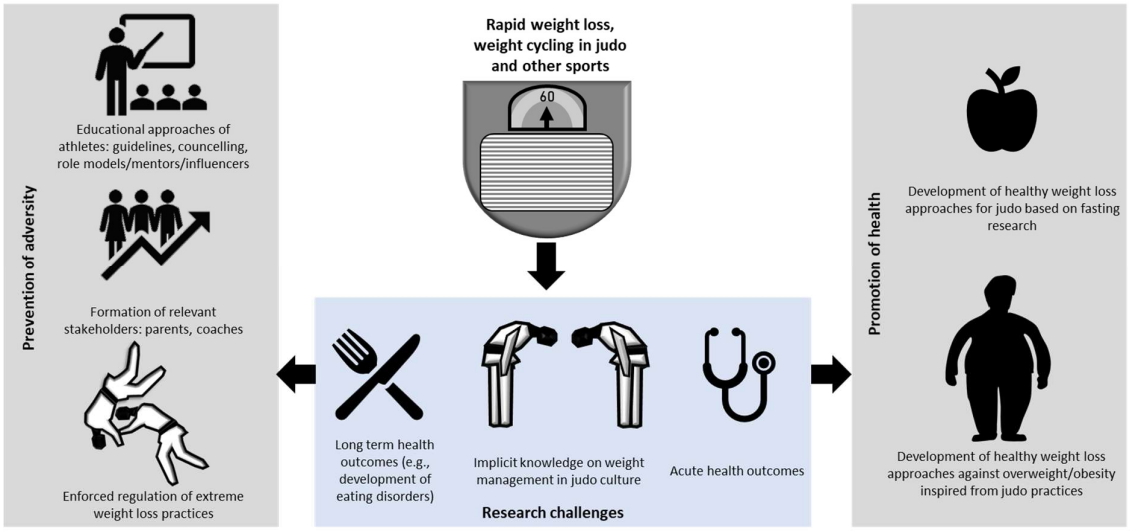

Figure 2. Research challenges and potential applications for disease prevention and health promotion.

In addition, we think that the existing knowledge on weight management that is intrinsically present in judo, has been insufficiently considered. Extracting and using such knowledge in a systematic way, and supplementing it with evidence-based knowledge from novel research on intermittent fasting research, could lead to improved guidelines for those aiming to lose weight for the purpose of competing in a specified weight category, and for people wishing to lose weight for other reasons.

The development of apps allowing tracking and organizing weight loss in systematic ways may offer additional possibilities to better investigate weight loss behaviors and offer support to athletes and non-athletes planning to lose weight. Especially gamified apps could be useful to improve the adherence of people struggling with being overweight or suffering from obesity, to weight loss programs. Apps that include virtual penalization (e.g., loss of game points) for non-achieved goals and rewards, such as bonus points, for every accomplishment, might help motivating overweight people interested in meeting their weight objectives in a timely, well-organized way – corresponding to many judo athletes achieving their weight loss goals before competitions.

In conclusion, health outcomes of rapid weight loss and weight cycling in judo to date still remain insufficiently understood, although research is continuously aiming to raise the awareness for potentially associated health problems. We believe that conceptualizing weight-management strategies from competitive judo for health-promoting purposes might benefit both athletes and patients struggling with obesity to achieve their weight-loss goals in a healthier manner.

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References

1. Stevens, J. *The way of Judo: A portrait of Jigoro Kano and his students*; Shambhala Publications: 2013.
2. Garbeloto, F.; Miarka, B.; Guimarães, E.; Gomes, F.R.F.; Tagusari, F.I.; Tani, G. A New Developmental Approach for Judo Focusing on Health, Physical, Motor, and Educational Attributes. *Int J Environ Res Public Health* **2023**, *20*, doi:10.3390/ijerph20032260.

 doi:10.20944/preprints202410.1549.v1

3. Andreoli, A.; Monteleone, M.; Van Loan, M.; Promenzio, L.; Tarantino, U.; De Lorenzo, A. Effects of different sports on bone density and muscle mass in highly trained athletes. *Medicine & Science in Sports & Exercise* **2001**, *33*, 507-511.
4. Kim, P.S.; Shin, Y.; Noh, S.; Jung, H.; Lee, C.; Kang, H. Beneficial effects of judo training on bone mineral density of high-school boys in Korea. *Biology of Sport* **2013**, *30*, 295.
5. Tenforde, A.S.; Fredericson, M. Influence of sports participation on bone health in the young athlete: a review of the literature. *PM&R* **2011**, *3*, 861-867.
6. Tsai, S.C.; Kao, C.H.; Wang, S.J. Comparison of bone mineral density between athletic and non-athletic Chinese male adolescents. *Kaohsiung J Med Sci* **1996**, *12*, 573-580.
7. Date, H.; Imamura, T.; Onitsuka, H.; Maeno, M.; Watanabe, R.; Nishihira, K.; Matsuo, T.; Eto, T. Differential increase in natriuretic peptides in elite dynamic and static athletes. *Circulation journal* **2003**, *67*, 691-696.
8. Tsopanakis, C.; Kotsarellis, D.; Tsopanakis, A. Plasma lecithin: cholesterol acyltransferase activity in elite athletes from selected sports. *Eur J Appl Physiol Occup Physiol* **1988**, *58*, 262-265.
9. Jacini, W.F.; Cannonieri, G.C.; Fernandes, P.T.; Bonilha, L.; Cendes, F.; Li, L.M. Can exercise shape your brain? Cortical differences associated with judo practice. *J Sci Med Sport* **2009**, *12*, 688-690, doi:10.1016/j.jsams.2008.11.004.
10. Almansba, R.; Sterkowicz-Przybycien, K.; Sterkowicz, S.; Mahdad, D.; Boucher, J.P.; Calmet, M.; Comtois, A.S. Postural balance control ability of visually impaired and unimpaired judoists. *Archives of Budo* **2012**, *8*, 153-158.
11. Mesure, S.; Amblard, B.; Crémieux, J. Effect of physical training on head—hip co-ordinated movements during unperturbed stance. *Neuroreport* **1997**, *8*, 3507-3512.
12. Perrin, P.; Deviterne, D.; Hugel, F.; Perrot, C. Judo, better than dance, develops sensorimotor adaptabilities involved in balance control. *Gait & posture* **2002**, *15*, 187-194.
13. Mikheev, M.; Mohr, C.; Afanasiev, S.; Landis, T.; Thut, G. Motor control and cerebral hemispheric specialization in highly qualified judo wrestlers. *Neuropsychologia* **2002**, *40*, 1209-1219.
14. Pocecco, E.; Ruedl, G.; Stankovic, N.; Sterkowicz, S.; Del Vecchio, F.B.; Gutiérrez-García, C.; Rousseau, R.; Wolf, M.; Kopp, M.; Miarka, B.; et al. Injuries in judo: a systematic literature review including suggestions for prevention. *Br J Sports Med* **2013**, *47*, 1139-1143, doi:10.1136/bjsports-2013-092886.
15. Tinsley, G.M.; La Bounty, P.M. Effects of intermittent fasting on body composition and clinical health markers in humans. *Nutr Rev* **2015**, *73*, 661-674, doi:10.1093/nutrit/nuv041.
16. Sun, M.L.; Yao, W.; Wang, X.Y.; Gao, S.; Varady, K.A.; Forslund, S.K.; Zhang, M.; Shi, Z.Y.; Cao, F.; Zou, B.J.; et al. Intermittent fasting and health outcomes: an umbrella review of systematic reviews and meta-analyses of randomised controlled trials. *EClinicalMedicine* **2024**, *70*, 102519, doi:10.1016/j.eclinm.2024.102519.
17. Tagde, P.; Tagde, S.; Bhattacharya, T.; Tagde, P.; Akter, R.; Rahman, M.H. Multifaceted Effects of Intermittent Fasting on the Treatment and Prevention of Diabetes, Cancer, Obesity or Other Chronic Diseases. *Curr Diabetes Rev* **2022**, *18*, e131221198789, doi:10.2174/1573399818666211213103315.
18. Mattson, M.P.; Longo, V.D.; Harvie, M. Impact of intermittent fasting on health and disease processes. *Ageing Res Rev* **2017**, *39*, 46-58, doi:10.1016/j.arr.2016.10.005.
19. Conde-Pipó, J.; Mora-Fernandez, A.; Martinez-Bebia, M.; Gimenez-Blasi, N.; Lopez-Moro, A.; Latorre, J.A.; Almendros-Ruiz, A.; Requena, B.; Mariscal-Arcas, M. Intermittent Fasting: Does It Affect Sports Performance? A Systematic Review. *Nutrients* **2024**, *16*, doi:10.3390/nu16010168.
20. White, T.; Kirk, C. Pre-competition body mass loss characteristics of Brazilian jiu-jitsu competitors in the United Kingdom. *Nutr Health* **2021**, *27*, 387-394, doi:10.1177/0260106020983800.
21. Matthews, J.J.; Stanhope, E.N.; Godwin, M.S.; Holmes, M.E.J.; Artioli, G.G. The Magnitude of Rapid Weight Loss and Rapid Weight Gain in Combat Sport Athletes Preparing for Competition: A Systematic Review. *Int J Sport Nutr Exerc Metab* **2019**, *29*, 441–452, doi:10.1123/ijsnem.2018-0165.
22. Martínez-Rodríguez, A.; Vicente-Salar, N.; Montero-Carretero, C.; Cervelló-Gimeno, E.; Roche, E. Weight Loss Strategies in Male Competitors of Combat Sport Disciplines. *Medicina (Kaunas)* **2021**, *57*, doi:10.3390/medicina57090897.
23. Karrer, Y.; Halioua, R.; Mötteli, S.; Iff, S.; Seifritz, E.; Jäger, M.; Claussen, M.C. Disordered eating and eating disorders in male elite athletes: a scoping review. *BMJ open sport & exercise medicine* **2020**, *6*, e000801.
24. Gwyther, K.; Pilkington, V.; Bailey, A.P.; Mountjoy, M.; Bergeron, M.F.; Rice, S.M.; Purcell, R. Mental health and well-being of elite youth athletes: a scoping review. *Br J Sports Med* **2024**, *58*, 1011-1019, doi:10.1136/bjsports-2024-108244.
25. Chapa, D.A.N.; Johnson, S.N.; Richson, B.N.; Bjorlie, K.; Won, Y.Q.; Nelson, S.V.; Ayres, J.; Jun, D.; Forbush, K.T.; Christensen, K.A.; et al. Eating-disorder psychopathology in female athletes and non-athletes: A meta-analysis. *Int J Eat Disord* **2022**, *55*, 861-885, doi:10.1002/eat.23748.
26. Warburton, D.E.; Nicol, C.W.; Bredin, S.S. Health benefits of physical activity: the evidence. *Cmaj* **2006**, *174*, 801-809, doi:10.1503/cmaj.051351.

27. Origua Rios, S.; Marks, J.; Estevan, I.; Barnett, L.M. Health benefits of hard martial arts in adults: a systematic review. *J Sports Sci* **2018**, *36*, 1614-1622, doi:10.1080/02640414.2017.1406297.
28. Franchini, E.; Del Vecchio, F.B.; Matsushigue, K.A.; Artioli, G.G. Physiological profiles of elite judo athletes. *Sports Med* **2011**, *41*, 147-166, doi:10.2165/11538580-000000000-00000.
29. Pocecco, E.; Faulhaber, M.; Franchini, E.; Burtscher, M. Aerobic power in child, cadet and senior judo athletes. *Biology of Sport* **2012**, *29*, 217-222.
30. Pocecco, E.; Burtscher, M. Sex-differences in response to arm and leg ergometry in juvenile judo athletes. *Archives of Budo* **2013**, *9*, 181-187.
31. Laskowski, R.; Wysocki, K.; Multan, A.; Haga, S. Changes in cardiac structure and function among elite judoists resulting from long-term judo practice. *J Sports Med Phys Fitness* **2008**, *48*, 366-370.
32. Torres-Luque, G.; Hernández-García, R.; Escobar-Molina, R.; Garatachea, N.; Nikolaidis, P.T. Physical and Physiological Characteristics of Judo Athletes: An Update. *Sports (Basel)* **2016**, *4*, doi:10.3390/sports4010020.
33. Stavrinou, P.S.; Argyrou, M.; Hadjicharalambous, M. Physiological and metabolic responses during a simulated judo competition among cadet athletes. *International Journal of Performance Analysis in Sport* **2016**, *16*, 848-859.
34. Julio, U.F.; Panissa, V.L.G.; Esteves, J.V.; Cury, R.L.; Agostinho, M.F.; Franchini, E. Energy-System Contributions to Simulated Judo Matches. *Int J Sports Physiol Perform* **2017**, *12*, 676-683, doi:10.1123/ijspp.2015-0750.
35. Pocecco, E.; Gatterer, H.; Ruedl, G.; Burtscher, M. Specific exercise testing in judo athletes. *Archives of Budo* **2012**, *8*, 133-139.
36. Degoutte, F.; Jouanel, P.; Filaire, E. Energy demands during a judo match and recovery. *Br J Sports Med* **2003**, *37*, 245-249, doi:10.1136/bjsm.37.3.245.
37. Prouteau, S.; Pelle, A.; Collomp, K.; Benhamou, L.; Courteix, D. Bone density in elite judoists and effects of weight cycling on bone metabolic balance. *Med Sci Sports Exerc* **2006**, *38*, 694-700, doi:10.1249/01.mss.0000210207.55941.fb.
38. Smith, R.L.; Soeters, M.R.; Wüst, R.C.I.; Houtkooper, R.H. Metabolic Flexibility as an Adaptation to Energy Resources and Requirements in Health and Disease. *Endocr Rev* **2018**, *39*, 489-517, doi:10.1210/er.2017-00211.
39. Huang, J.; Li, Y.; Chen, M.; Cai, Z.; Cai, Z.; Jiang, Z. Comparing caloric restriction regimens for effective weight management in adults: a systematic review and network meta-analysis. *Int J Behav Nutr Phys Act* **2024**, *21*, 108, doi:10.1186/s12966-024-01657-9.
40. Horne, B.D.; Muhlestein, J.B.; Anderson, J.L. Health effects of intermittent fasting: hormesis or harm? A systematic review. *Am J Clin Nutr* **2015**, *102*, 464-470, doi:10.3945/ajcn.115.109553.
41. Ozcan, M.; Abdellatif, M.; Javaheri, A.; Sedej, S. Risks and Benefits of Intermittent Fasting for the Aging Cardiovascular System. *Can J Cardiol* **2024**, *40*, 1445-1457, doi:10.1016/j.cjca.2024.02.004.
42. Khalafi, M.; Symonds, M.E.; Maleki, A.H.; Sakhaei, M.H.; Ehsanifar, M.; Rosenkranz, S.K. Combined versus independent effects of exercise training and intermittent fasting on body composition and cardiometabolic health in adults: a systematic review and meta-analysis. *Nutr J* **2024**, *23*, 7, doi:10.1186/s12937-023-00909-x.
43. Kazeminasab, F.; Behzadnejad, N.; Cerqueira, H.S.; Santos, H.O.; Rosenkranz, S.K. Effects of intermittent fasting combined with exercise on serum leptin and adiponectin in adults with or without obesity: a systematic review and meta-analysis of randomized clinical trials. *Front Nutr* **2024**, *11*, 1362731, doi:10.3389/fnut.2024.1362731.
44. Cheuvront, S.N.; Kenefick, R.W. Dehydration: physiology, assessment, and performance effects. *Compr Physiol* **2014**, *4*, 257-285, doi:10.1002/cphy.c130017.
45. Franchini, E.; Brito, C.J.; Artioli, G.G. Weight loss in combat sports: physiological, psychological and performance effects. *J Int Soc Sports Nutr* **2012**, *9*, 52, doi:10.1186/1550-2783-9-52.
46. Zarrouk, N.; Hammouda, O.; Latiri, I.; Adala, H.; Bouhlel, E.; Rebai, H.; Dogui, M. Ramadan fasting does not adversely affect neuromuscular performances and reaction times in trained karate athletes. *J Int Soc Sports Nutr* **2016**, *13*, 18, doi:10.1186/s12970-016-0130-2.
47. Chaouachi, A.; Coutts, A.J.; Chamari, K.; Wong del, P.; Chaouachi, M.; Chtara, M.; Roky, R.; Amri, M. Effect of Ramadan intermittent fasting on aerobic and anaerobic performance and perception of fatigue in male elite judo athletes. *J Strength Cond Res* **2009**, *23*, 2702-2709, doi:10.1519/JSC.0b013e3181bc17fc.
48. Wan, K.W.; Dai, Z.H.; Ho, R.S.; Wendy Yajun, H.; Wong, S.H. Comparative effects of time-restricted feeding versus normal diet on physical performance and body composition in healthy adults with regular exercise habits: a systematic review and meta-analysis. *BMJ Open Sport Exerc Med* **2024**, *10*, e001831, doi:10.1136/bmjsem-2023-001831.
49. Paukkonen, I.; Törrönen, E.N.; Lok, J.; Schwab, U.; El-Nezami, H. The impact of intermittent fasting on gut microbiota: a systematic review of human studies. *Front Nutr* **2024**, *11*, 1342787, doi:10.3389/fnut.2024.1342787.
50. Chaouachi, A.; Chamari, K.; Roky, R.; Wong, P.; Mbazaa, A.; Bartagi, Z.; Amri, M. Lipid profiles of judo athletes during Ramadan. *Int J Sports Med* **2008**, *29*, 282-288, doi:10.1055/s-2007-965338.

51. Chaouachi, A.; Coutts, A.J.; Wong del, P.; Roky, R.; Mbazaa, A.; Amri, M.; Chamari, K. Haematological, inflammatory, and immunological responses in elite judo athletes maintaining high training loads during Ramadan. *Appl Physiol Nutr Metab* **2009**, *34*, 907-915, doi:10.1139/h09-095.
52. Aloui, A.; Chtourou, H.; Masmoudi, L.; Chaouachi, A.; Chamari, K.; Souissi, N. Effects of Ramadan fasting on male judokas' performances in specific and non-specific judo tasks. *Biological Rhythm Research* **2013**, *44*, 645-654.
53. Chaouachi, A.; Leiper, J.B.; Souissi, N.; Coutts, A.J.; Chamari, K. Effects of Ramadan intermittent fasting on sports performance and training: a review. *Int J Sports Physiol Perform* **2009**, *4*, 419-434, doi:10.1123/ijspp.4.4.419.
54. Lalia, C.; Ali, A.R.; Adel, B.; Asli, H.; Othman, B. Effects of caloric restriction on anthropometrical and specific performance in highly-trained university judo athletes. *Physical education of students* **2019**, *23*, 30-36.
55. Aloui, A.; Chtourou, H.; Briki, W.; Tabben, M.; Chaouachi, A.; Souissi, N.; Shephard, R.J.; Chamari, K. Rapid weight loss in the context of Ramadan observance: recommendations for judokas. *Biol Sport* **2016**, *33*, 407-413, doi:10.5604/20831862.1224098.
56. Correia, J.M.; Santos, I.; Pezarat-Correia, P.; Minderico, C.; Mendonca, G.V. Effects of Intermittent Fasting on Specific Exercise Performance Outcomes: A Systematic Review Including Meta-Analysis. *Nutrients* **2020**, *12*, doi:10.3390/nu12051390.
57. Artioli, G.G.; Franchini, E.; Nicastro, H.; Sterkowicz, S.; Solis, M.Y.; Lancha, A.H., Jr. The need of a weight management control program in judo: a proposal based on the successful case of wrestling. *J Int Soc Sports Nutr* **2010**, *7*, 15, doi:10.1186/1550-2783-7-15.
58. Fortes, L.S.; Costa, B.D.; Paes, P.P.; Cyrino, E.S.; Vianna, J.M.; Franchini, E. Effect of rapid weight loss on physical performance in judo athletes: is rapid weight loss a help for judokas with weight problems? *International Journal of Performance Analysis in Sport* **2017**, *17*, 763-773.
59. Stavrinou, P.S.; Aphamis, G.; Giannaki, G.C. Weight Loss for Judo Competition: Literature Review and Practical Applications. *The Arts and Sciences of Judo* **2022**, *2*, 19.
60. Trivic, T.; Roklicer, R.; Zenic, N.; Modric, T.; Milovancev, A.; Lukic-Sarkanovic, M.; Maksimovic, N.; Bianco, A.; Carraro, A.; Drid, P. Rapid weight loss can increase the risk of acute kidney injury in wrestlers. *BMJ Open Sport Exerc Med* **2023**, *9*, e001617, doi:10.1136/bmjsem-2023-001617.
61. Oppliger, R.A.; Steen, S.A.; Scott, J.R. Weight loss practices of college wrestlers. *Int J Sport Nutr Exerc Metab* **2003**, *13*, 29-46, doi:10.1123/ijsnem.13.1.29.
62. Brito, C.J.; Roas, A.F.; Brito, I.S.; Marins, J.C.; Córdova, C.; Franchini, E. Methods of body mass reduction by combat sport athletes. *Int J Sport Nutr Exerc Metab* **2012**, *22*, 89-97, doi:10.1123/ijsnem.22.2.89.
63. Kons, R.L.; Athayde, M.S.D.S.; Follmer, B.; Detanico, D. Methods and magnitudes of rapid weight loss in judo athletes over pre-competition periods. *Human Movement* **2017**, *18*, 49-55.
64. Artioli, G.G.; Gualano, B.; Franchini, E.; Scagliusi, F.B.; Takesian, M.; Fuchs, M.; Lancha, A.H., Jr. Prevalence, magnitude, and methods of rapid weight loss among judo competitors. *Med Sci Sports Exerc* **2010**, *42*, 436-442, doi:10.1249/MSS.0b013e3181ba8055.
65. Berkovich, B.E.; Eliakim, A.; Nemet, D.; Stark, A.H.; Sinai, T. Rapid Weight Loss Among Adolescents Participating In Competitive Judo. *Int J Sport Nutr Exerc Metab* **2016**, *26*, 276-284, doi:10.1123/ijsnem.2015-0196.
66. Artioli, G.G.; Saunders, B.; Iglesias, R.T.; Franchini, E. It is Time to Ban Rapid Weight Loss from Combat Sports. *Sports Med* **2016**, *46*, 1579-1584, doi:10.1007/s40279-016-0541-x.
67. De Crée, C. Effects of rapid reduction of body mass on performance indices and proneness to injury in jūdōka. A critical appraisal from a historical, gender-comparative and coaching perspective. *Open Access Journal of Exercise and Sports Medicine* **2017**, *1*, 1-33.
68. CDC. Hyperthermia and dehydration-related deaths associated with intentional rapid weight loss in three collegiate wrestlers--North Carolina, Wisconsin, and Michigan, November-December 1997. *MMWR Morb Mortal Wkly Rep* **1998**, *47*, 105-108.
69. Lakicevic, N.; Roklicer, R.; Bianco, A.; Mani, D.; Paoli, A.; Trivic, T.; Ostojic, S.M.; Milovancev, A.; Maksimovic, N.; Drid, P. Effects of Rapid Weight Loss on Judo Athletes: A Systematic Review. *Nutrients* **2020**, *12*, doi:10.3390/nu12051220.
70. Štangar, M.; Štangar, A.; Shtyrba, V.; Cigić, B.; Benedik, E. Rapid weight loss among elite-level judo athletes: methods and nutrition in relation to competition performance. *J Int Soc Sports Nutr* **2022**, *19*, 380-396, doi:10.1080/15502783.2022.2099231.
71. Manore, M.M. Weight Management for Athletes and Active Individuals: A Brief Review. *Sports Med* **2015**, *45 Suppl 1*, S83-92, doi:10.1007/s40279-015-0401-0.
72. Sundgot-Borgen, J.; Torstveit, M.K. Prevalence of eating disorders in elite athletes is higher than in the general population. *Clin J Sport Med* **2004**, *14*, 25-32, doi:10.1097/00042752-200401000-00005.
73. Doherty, C.S.; Fortington, L.V.; Barley, O.R. Prevalence of disordered eating and its relationship with rapid weight loss amongst male and female combat sport competitors: A prospective study. *J Sci Med Sport* **2024**, doi:10.1016/j.jsams.2024.06.007.

74. Mathisen, T.F.; Kumar, R.S.; Svantorp-Tveiten, K.M.E.; Sundgot-Borgen, J. Empowered, Yet Vulnerable: Motives for Sport Participation, Health Correlates, and Experience of Sexual Harassment in Female Combat-Sport Athletes. *Sports (Basel)* **2022**, *10*, doi:10.3390/sports10050068.
75. Walter, N.; Heinen, T.; Elbe, A.-M. Factors associated with disordered eating and eating disorder symptoms in adolescent elite athletes. *Sports Psychiatry: Journal of Sports and Exercise Psychiatry* **2022**, *1*, 47.
76. Giel, K.E.; Bulik, C.M.; Fernandez-Aranda, F.; Hay, P.; Keski-Rahkonen, A.; Schag, K.; Schmidt, U.; Zipfel, S. Binge eating disorder. *Nature reviews disease primers* **2022**, *8*, 16.
77. Morales, J.; Ubasart, C.; Solana-Tramunt, M.; Villarrasa-Sapiña, I.; González, L.-M.; Fukuda, D.; Franchini, E. Effects of rapid weight loss on balance and reaction time in elite judo athletes. *International journal of sports physiology and performance* **2018**, *13*, 1371-1377.
78. Fortes, L.d.S.; Lira, H.A.A.d.S.; Ferreira, M.E.C. Effect of rapid weight loss on decision-making performance in judo athletes. *Journal of Physical Education* **2017**, *28*, e2817.
79. Lakicevic, N.; Thomas, E.; Isacco, L.; Tcymbal, A.; Pettersson, S.; Roklicer, R.; Tubic, T.; Paoli, A.; Bianco, A.; Drid, P. Rapid weight loss and mood states in judo athletes: A systematic review. *European Review of Applied Psychology* **2024**, *74*, 100933, doi:https://doi.org/10.1016/j.erap.2023.100933.
80. Pettersson, S.; Berg, C.M. Hydration status in elite wrestlers, judokas, boxers, and taekwondo athletes on competition day. *Int J Sport Nutr Exerc Metab* **2014**, *24*, 267-275, doi:10.1123/ijsnem.2013-0100.
81. Degoutte, F.; Jouanel, P.; Bègue, R.J.; Colombier, M.; Lac, G.; Pequignot, J.M.; Filaire, E. Food restriction, performance, biochemical, psychological, and endocrine changes in judo athletes. *Int J Sports Med* **2006**, *27*, 9-18, doi:10.1055/s-2005-837505.
82. Reljic, D.; Feist, J.; Jost, J.; Kieser, M.; Friedmann-Bette, B. Rapid body mass loss affects erythropoiesis and hemolysis but does not impair aerobic performance in combat athletes. *Scand J Med Sci Sports* **2016**, *26*, 507-517, doi:10.1111/sms.12485.
83. Umeda, T.; Nakaji, S.; Shimoyama, T.; Yamamoto, Y.; Totsuka, M.; Sugawara, K. Adverse effects of energy restriction on myogenic enzymes in judoists. *J Sports Sci* **2004**, *22*, 329-338, doi:10.1080/02640410310001404446.
84. Roklicer, R.; Lakicevic, N.; Stajer, V.; Trivic, T.; Bianco, A.; Mani, D.; Milosevic, Z.; Maksimovic, N.; Paoli, A.; Drid, P. The effects of rapid weight loss on skeletal muscle in judo athletes. *J Transl Med* **2020**, *18*, 142, doi:10.1186/s12967-020-02315-x.
85. Tayeb, B.; Alger, L. Rapid weight loss in female judokas during the pre-competitive period and the risk of eating disorders. *El Mohtaref J. Sport. Sci. Soc. Hum. Sci* **2022**, *9*, 520-529.
86. Rouveix, M.; Bouget, M.; Pannafieux, C.; Champely, S.; Filaire, E. Eating attitudes, body esteem, perfectionism and anxiety of judo athletes and nonathletes. *Int J Sports Med* **2007**, *28*, 340-345, doi:10.1055/s-2006-924334.
87. Yoshida, E.; Hayashida, H.; Sakurai, T.; Kawasaki, K. Evidence of weight loss in junior female judo athletes affects their development. *Front Sports Act Living* **2024**, *6*, 1420856, doi:10.3389/fspor.2024.1420856.
88. Filaire, E.; Rouveix, M.; Pannafieux, C.; Ferrand, C. Eating Attitudes, Perfectionism and Body-esteem of Elite Male Judoists and Cyclists. *J Sports Sci Med* **2007**, *6*, 50-57.
89. Escobar-Molina, R.; Rodríguez-Ruiz, S.; Gutiérrez-García, C.; Franchini, E. Weight loss and psychological-related states in high-level judo athletes. *Int J Sport Nutr Exerc Metab* **2015**, *25*, 110-118, doi:10.1123/ijsnem.2013-0163.
90. Uchizawa, A.; Kondo, E.; Lakicevic, N.; Sagayama, H. Differential Risks of the Duration and Degree of Weight Control on Bone Health and Menstruation in Female Athletes. *Frontiers in Nutrition* **2022**, *9*, 875802.
91. Lebron, M.A.; Stout, J.R.; Fukuda, D.H. Physiological Perturbations in Combat Sports: Weight Cycling and Metabolic Function-A Narrative Review. *Metabolites* **2024**, *14*, doi:10.3390/metabo14020083.
92. Maksimovic, N.; Cvjeticanin, O.; Rossi, C.; Manojlovic, M.; Roklicer, R.; Bianco, A.; Carraro, A.; Sekulic, D.; Milovancev, A.; Trivic, T.; et al. Prevalence of metabolic syndrome and its association with rapid weight loss among former elite combat sports athletes in Serbia. *BMC Public Health* **2024**, *24*, 245, doi:10.1186/s12889-024-17763-z.
93. Barley, O.R.; Chapman, D.W.; Abbiss, C.R. The Current State of Weight-Cutting in Combat Sports-Weight-Cutting in Combat Sports. *Sports (Basel)* **2019**, *7*, doi:10.3390/sports7050123.
94. Zilse, M.P.P.; Bennemann, G.D.; Cavagnari, M.A.V.; Paludo, A.C.; Moura, P.N.d. Risk behavior for eating disorders, perception of body image and food consumption in adolescent judo practitioners. *Jornal Brasileiro de Psiquiatria* **2024**, *73*, e20220071.
95. Schnitzer, M.; Peters, M.; Scheiber, S.; Pocecco, E. Perception of the culture and education programme of the Youth Olympic Games by the participating athletes: A case study for Innsbruck 2012. *The International Journal of the History of Sport* **2014**, *31*, 1178-1193.
96. Sansone, R.A.; Sawyer, R. Weight loss pressure on a 5 year old wrestler. *Br J Sports Med* **2005**, *39*, e2, doi:10.1136/bjsm.2004.013136.

 doi:10.20944/preprints202410.1549.v1

97. Ludwig, D.S.; Aronne, L.J.; Astrup, A.; de Cabo, R.; Cantley, L.C.; Friedman, M.I.; Heymsfield, S.B.; Johnson, J.D.; King, J.C.; Krauss, R.M. The carbohydrate-insulin model: a physiological perspective on the obesity pandemic. *The American journal of clinical nutrition* **2021**, *114*, 1873-1885.