Rapid Weight Loss

Subjects: Sport Sciences
Contributor: Nemanja Lakicevic

Since combat sports are weight-divided, many athletes take part in rapid weight loss so they can compete in a lower weight class and presumably gain advantage over their lighter opponents. This practice is associated with many health complications and performance decrements that can range from transient to chronic.

Keywords: weight cutting ; making weight ; creatinine ; blood urea nitrogen ; urine specific gravity ; renal system ; health ; performance

1. Introduction

The weight division rules in combat sports have been established in order to give every athlete a fair chance to compete in his/her given category. However, combat sports athletes regularly engage in rapid weight loss (RWL) so they can compete in the upper spectrum of a lower-weight category and presumably gain the competitive advantage over their lighter opponents. The phenomenon of RWL is omnipresent in combat sports [1], but varies in terms of its prevalence and percentage of weight lost prior to competition. Despite a growing body of evidence admonishing this type of behavior, athletes still persist in this practice with prevalence of RWL reaching 90% in some combat sports [2].

As nearly 65% of the human body is made of water, which makes it a good source of significant and temporary RWL [3], intentional dehydration is the culprit of RWL [4] and thus it seems reasonable to expect its great influence over kidney function (renal system). To date, a considerable number of studies have been conducted on the effects of acute dehydration in combat sports, both solely and within RWL, but to our knowledge, no comprehensive review has been published on the impact of RWL on kidney function. Therefore, the aim of this study was to thoroughly review the literature to determine the effects of RWL on kidney function in combat sport athletes.

2. Materials and Methods

EndNote software The following string was applied: “rapid weight loss” AND “kidneys”; “rapid weight loss” AND “kidney function”; “rapid weight loss” AND “renal system”; “rapid weight loss“ AND “renal function”; “making weight” AND kidneys; “making weight” AND “kidney function”; “making weight” AND “renal system”; “making weight” AND “renal function”; “weight-cutting” AND kidneys; “weight-cutting” AND “kidney function”; “weight-cutting” AND “renal system”; “weight-cutting” AND “renal function”. Once the search was completed, article screening was carried out in a three-step procedure: title reading, abstract reading and finally full-text reading. Notably, investigators were not blinded to the manuscripts, study title, authors or associated institutions during the selection process.

Only original articles written in English and published in peer-reviewed journals were considered for inclusion within this review. Combat sport athletes (Olympic and non-Olympic sports) had to engage in RWL which prompted ~5% weight loss within seven days or less. The date limit for publication period was set from the year 2005 until February 2021. Various formats of publications, such as reviews, meta-analyses, abstracts, citations, scientific conference abstracts, opinion pieces, books, book reviews, statements, letters, editorials, non-peer reviewed journal articles and commentaries, were excluded.

Essential information about included studies was delineated through tables (Microsoft Word 2016, Microsoft, Washington, DC, USA) while a narrative description was adopted to depict certain specifics about a particular study that expanded beyond tabular explanation. Retrieved data acquired from included articles dealt with the influence of RWL on biomarkers of kidney function.

The Physiotherapy Evidence Database (PEDro) scale was used for risk of bias assessment [5]. The PEDro checklist contains questions regarding eligibility criteria, sample randomization and blinding of the subjects and researchers. The maximum score a study could receive is 11, with higher scores denoting greater quality. statistical method was conducted in SPSS (IBM, New York, NY, USA, v.20) to determine the level of agreement between two scholars with reference to scoring of included studies.

3. Results

Due to lack of relevance or inadequate study design, only three studies found through systematic search met our inclusion criteria. In addition, a senior researcher (full professor) suggested another seven studies which did not include keywords used in the initial search, but were found by searching bibliographies of other studies, and met our inclusion criteria with respect to study design. The retrieved studies were comprised of athletes training Muay Thai [6], wrestling [7][8][9], Taekwondo [10], mixed martial arts [11][12][13] and judo [14], which included a total of 171 participants (Table 1). After article acquisition, we identified creatinine (Cr) and blood urea nitrogen (BUN) as the most commonly detected biomarkers used to determine the influence of RWL on kidney function, while urine specific gravity (USG) indicated the level of dehydration of combat sport athletes.

, the authors recruited 21 high-level Muay Thai fighters (m = 13, f = 8; 25.8 ± 2.52 years; 68.03 ± 11.56 kg; 1.71 ± 0.08 m) to examine the effects of supervised RWL and rapid weight gain on various biomarkers, hormones and body composition. The RWL lasted 3 days and was primarily induced by severe caloric restriction (−1000 kcal per day) whereby less than 30 g of carbohydrates per day was ingested, while 2 g of protein per kg of body mass per day and 0.5 g of fats per kg of body mass per day were consumed. The main emphasis was placed on glycogen depletion from muscle and liver deposits, which would result in significant loss of body water. In addition, as a part of supervised RWL, all participants received dietary micronutrient and phytochemical supplements daily.

Over a period of two to three weeks, athletes had to restrict their caloric intake mainly by decreasing carbohydrate and fat intake, while protein intake was advised to be 2 g per kilogram daily. During initial RWL, energy intake was restricted to 800–2000 kcal per day depending on the daily energy expenditure and the amount of weight loss. However, final weight cut was achieved over the last two days mainly by perspiration (heavy exercise in a hot sauna) whereby extreme dehydration was applied and caloric intake was 500–1000 kcal daily (including electrolyte solutions provided). Additionally, there was a significant correlation between reduced lean body mass and increased serum Cr ($p \leq 0.001$).

The authors elaborated on the pre-competition weight loss patterns and found that 62.5% of the participants lost weight whereas 37.5% did not. Among those engaging in weight loss, 60% of them prompted RWL 1-7 days prior to competition whereas 40% of them performed RWL 8-14 days before the competition. Results showed that RWL group reduced −5.73% of their body weight, while reductions of −11.91% and −4.27%, were detected for fat mass and fat free mass, respectively. In contrast, non-weight loss group did not show statistically significant differences in terms of body mass index and fat mass while statistically significant differences occurred with respect to fat free mass and total body water ($p < 0.05$).

A study by Ozkan and Cicioglu [15] on 69 wrestlers (22.51 ± 2.49 years, 174.54 ± 6.59 cm, 78.98 ± 15.87 kg) examined the impact of the RWL phase prior to the Turkish Wrestling Championship. A special emphasis was placed on the effects of dehydration during a 1–7-day time-frame. The results showed that 55% of athletes underwent RWL whereby 4.55 ± 1.87% of body weight was lost. The group that was voluntarily subjected to RWL showed significant increases in BUN when compared to group that did not lose weight ($p < 0.05$).

[10], 10 taekwondo athletes (21.1 ± 5.48 years, 1.74 ± 0.08 m, 71.6 ± 11.1 kg) were subjected to either RWL that included 5% weight loss achieved over 4 days or gradual weight loss (GWL) that was achieved over 4 weeks. During RWL, weight reduction was attained via individually used methods which included elevated training intensity and training sessions with thermal clothing, fasting and dehydration. Conversely, the GWL group achieved weight loss primarily by combining exercise with minimal caloric intake. However, all athletes continued their normal training schedule (6–8 h per week) with an additional running training session (1 h/week).

Sixteen hours after RWL (self-selected methods), all of the subjects consumed water ad libitum and ate an identical supervised diet. The diet was supplemented with wheat flour as placebo for eight wrestlers and with sodium citrate (buffering agent) for the other eight wrestlers. Urine specific gravity (USG) was used as an indicator of hydration status. However, USG returned to normal values during the 16 h recovery, and no between-group differences existed in USG at any stage of the study.

Eight judo athletes (19.3 ± 2.0 years, 178.1 ± 6.3 cm, 81.7 ± 10.7 kg) took part in a study by Drid et al. [14] where authors evaluated the effects of a 7-day RWL (restriction of fluid and food intake) on body composition and biomarkers of creatine metabolism during a pre-competition period. Still, athletes were prescribed vitamins and electrolyte supplements containing no calories. The volunteers were assessed on two occasions separated by seven days.

[12] who aimed to quantify the extent of dehydration as an essential component of RWL prior to an MMA event. A significant increase ($p < 0.001$) was found for USG from the official weigh-in to 2 h before competition. when assessed 2 h before competition. A matter of concern is that only 23% of the subjects were classified as "well hydrated" (USG < 1.010) in the 2-h period before competition.

The athlete underwent several phases in order to reduce weight rapidly, but overall followed a "low carbohydrate" diet for the duration of the entire study. From −4 to −1 week, energy intake was reduced to 1300–1500 kcal, occurring by a reduction in protein intake to approximately 1 g/kg body mass. The athlete also engaged in water loading where 8 L of water was consumed daily over a 4-day period prior to water intake being reduced to 0.25 L until the evening before weigh-in. Phase four consisted of rapid weight gain prior to the competitive event and phase five

Fourteen male MMA fighters (23 ± 4 years; 1.76 ± 0.4 m; 76.8 ± 9.3 kg) volunteered to participate in study by Barley et al. [11] who sought to examine the influence of acute dehydration on physical performance and physiology in MMA athletes. Weight loss was prompted mainly through dehydration, where the RWL group took part in 3-h cycling at 60 W in 40 °C to induce 5% dehydration, while the control group underwent the same exercise protocol but in a thermoneutral environment (25 °C) exercise, followed by ad libitum fluid/food intake. USG was significantly elevated from the baseline following RWL and was significantly greater than in the control group at 20 min (1.025 ± 0.01; $p < 0.01$) and 24 h post (1.022; $p < 0.01$) RWL.

4. Discussion

The aim of this study was to review the existing literature in order to examine the effects of RWL on kidney function in combat sport athletes. Retrieved studies have demonstrated significantly increased Cr and BUN, and thus indicated acute kidney damage as a consequence of RWL. It is becoming increasingly recognized that acute kidney injury and chronic kidney disease are closely linked and likely promote one another [16]. However, USG values should be observed with caution, as many factors, such as weight reduction, training, urine metabolites, increased muscle mass and supplement consumption, may artificially increase urine concentrations, leading to false-positive findings [17].

It is important to outline that the included studies varied vastly in terms of research design, particularly in the number of days (or even weeks) permitted for the RWL procedure. Knowing that this fundamental aspect of research design was markedly different among included studies, it is very hard to make a comparison with respect to a degree of acute kidney damage. Indeed, there is no universally accepted definition of weight cycling but many possible variations on the same theme [18]. Still, the common feature between all RWL approaches is to maximize weight loss during the last couple of days prior to weigh-in (competition).

The current literature recognizes that dehydration is well known to be associated with acute renal dysfunction, but was originally considered reversible and to be associated with no long-term effects on the kidney function [19]. However, novel discoveries have led to recognition that even mild dehydration may be a risk factor in progression of all types of chronic kidney diseases [19]. In the context of combat sports, dehydration has been associated with a reduced plasma volume [20], which consequently leads to an increase in blood viscosity, which further reflects on cardiovascular efficiency [21] and increases the risk of acute cardiovascular issues. [13] suggested that MMA athletes may be particularly sensitive to long-term kidney complications, as several MMA athletes have retired from the sport citing kidney disease as one of the main factors.

Based on these and other hazards of RWL eloquently described in the existing literature, it is for a good reason that experts in the field of combat sports are calling for RWL to be banned from combat sports [22]. According to Artioli et al. [22], RWL fulfills the World Anti-Doping Agency's criteria to be banned since it has the potential to enhance sport performance, it represents a health risk to the athlete and it violates the spirit of the sport. Ethical consequences of RWL are often overlooked, yet in the environment where it is widely accepted to drop one or two weight classes, all athletes may feel forced to follow this tendency to avoid unfair competition against a bigger and stronger opponent, resulting in an unfortunate cascade effect [22].

Gradual weight loss has been proposed as an alternative strategy to the current approach of RWL [1], whereby weight loss would be achieved at the slower rate and ideally from fat deposits. Referring to the existing situation of RWL in combat sports, the American College of Sports Medicine stated that key methods for weight loss (e.g., increased exercise, caloric deficit, fasting and various dehydration methods) primarily affect body water, glycogen content and lean body mass rather than targeting fat loss [4]. Using sophisticated body composition measurement devices to monitor athletes' weight oscillations during RWL would allow us to determine what type of bodily tissues are being lost, whereby training and diet can be adjusted accordingly to initiate fat loss.

Hoffman et al. [23] emphasized that an adequate intake of high-quality carbohydrates must be ensured as this macronutrient is a primary fuel used by combat sport athletes during training and competition. Of particular importance for combat sport athletes during RWL or gradual weight loss is sufficient protein intake, as during prolonged situations of low energy intake, elevated protein consumption appears to protect lean tissue and prevent or minimize the catabolic impact of insufficient caloric diets [24].

Personal efforts precluding RWL must be led by organizational legislation [25] that discourages RWL and emphasizes fairness that benefits the sport. A mandatory hydration test that accompanies weigh-in, minimal competitive weight determination that will be screened quarterly and narrowing the time-frame between weigh-in and competition are some of the strategies advocated by the experts to prevent RWL.

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