

Nutritional and Non-Nutritional Strategies Adopted by Mixed Martial Arts (MMA) Athletes during Rapid Weight Loss

ALESSANDRA ALEGRE DE MATOS

Laboratory and Innovation in Sports Sciences (UFRJ-Macaé)

Macaé Sports Secretary (SEMEL-PMM)

Postgraduate Program in Nutrition (UFRJ-RJ)

FERNANDA MACHADO TELES

Federal University of Rio de Janeiro (UFRJ)

ANDERSON PONTES MORALES

Laboratory and Innovation in Sports Sciences (UFRJ-Macaé)

Macaé Sports Secretary (SEMEL-PMM)

Higher Institutes of Education of CENSA (ISECENSA)

BEATRIZ GONÇALVES RIBEIRO

Laboratory and Innovation in Sports Sciences (UFRJ-Macaé)

Federal University of Rio de Janeiro (UFRJ)

Postgraduate Program in Nutrition (UFRJ-RJ)

TIAGO COSTA LEITE

Laboratory and Innovation in Sports Sciences (UFRJ-Macaé)

Federal University of Rio de Janeiro (UFRJ)

Abstract

Rapid weight loss (RWL) is a widespread practice among combat athletes in order to obtain a competitive advantage. The present study describes the prevalence of nutritional and non-nutritional strategies adopted by mixed martial arts (MMA) athletes to achieve RWL. Fifty male MMA athletes, mean age 25 ± 4.7 years, body mass 73 ± 8.8 kg, with competitive experience in MMA of 4.9 ± 2.9 years were included in the study. A previously validated standardized questionnaire containing objective and structured questions that had been adapted to the context of the sport was used. It was found that most of the athletes (84%) maintained hydration throughout RWL. Their choices of fluids after water, which was used by all, were fresh fruit juices (22%), isotonic drinks (14%), non-carbonated soft drinks (12%), coconut water (10%), maltodextrin (6%), and "normal" fizzy

drinks (2%). The nutritional and non-nutritional strategies most widely used were: low-calorie diet (86%), gradual diet (80%), use of plastic clothing (70%), sauna (60%), water restriction (54%), and total fasting for 24 hours (40%). The use of nutritional supplements was reported by 46 (92%) of the athletes. RWL should be discouraged in sport because of its potential damage to athletes' performance and health.

Keywords: performance, mixed martial arts, rapid weight loss, nutrition

INTRODUCTION

Mixed martial arts (MMA) is a sport that is growing in popularity and is often referred to as the fastest growing sport in the world. It is a full contact sport that combines skills from several combat sports, regulated under its own rules (Jetton et al., 2013). There are male and female competitions with their own specific weight divisions. At the main MMA events, the official weigh-in for the fight takes place between 24 and 36 hours before the fight. This creates an environment that is conducive for athletes to engage in rapid weight loss (RWL). RWL is defined as a $\geq 5\%$ reduction in body mass over a period of one week or less, mostly due to acute dehydration (Artioli et al., 2006, Pettersson et al., 2013).

It allows athletes to reduce their body mass considerably in a few days and thus reach the stipulated weight limit for their category. After the official weigh-in, the athlete has a window of 24 to 36 hours in which to recover their lost body mass either partially or completely, or even exceed their pre-RWL weight (Matthews & Nicholas, 2017). It is a method athletes employ to enter combat at a weight that exceeds their weight division, giving them an advantage over their opponent, who will be lighter and weaker, provided they themselves have not engaged in the same practice (Silva & Gagliardo, 2014, Fabrini et al., 2010). Although RWL before an MMA fight is lawful, it is associated with impaired health and athletic performance (Artioli et al., 2006, Fabrini et al., 2010, Jetton, et al., 2013). In this study, we

characterize the main nutritional and non-nutritional strategies of MMA athletes during RWL.

MATERIALS AND METHODS

This is a descriptive cross-sectional study of MMA athletes who train at gyms in the state of Rio de Janeiro, Brazil. This research was approved by the research ethics committee of Veiga de Almeida University (protocol 6092573). Fifty randomly selected male athletes ranging from 22 to 36 years old participated in the study. To evaluate their nutritional and non-nutritional strategies, they answered a previously validated standardized questionnaire with objective and structured questions (Artioli, 2010) that was adapted to the context of the sport and the objectives of the study, in order to guarantee greater reliability of the data.

Statistical analysis

The data analysis was based on the average, absolute, and relative frequencies obtained from the questionnaire responses. All the results were processed using Excel 9.0 for Windows (Microsoft).

RESULTS

Fifty MMA fighters were evaluated, all male, age 25 ± 4.7 years, body mass 73 ± 8.8 kg, with competitive experience in MMA of 4.9 ± 2.9 years. Fourteen percent of the respondents competed at state level, 52% at national level, and 34% at international level.

The analysis of the athletes' hydration habits during RWL found that most of them (84%) maintained normal hydration. Only one (2%) reported consuming no liquids in this period, while two (4%) reported consuming fluids "sometimes" and five (10%) "almost never" (Figure 1).

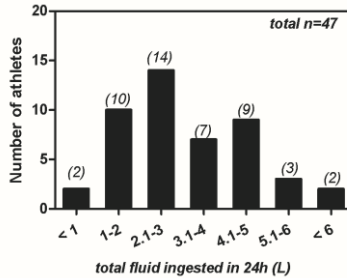


Figure 1: MMA hydration status in the pre-competition period

In relation to the amount of fluids ingested in a 24-hour period during RWL, 80% of the athletes reported intake of between 1 L and 5 L a day: 10 (20%) consumed 1–2 L, 14 (28%) consumed 2.1–3 L, seven (14%) consumed 3.1 – 4 L, and nine (18%) consumed 4.1–5 L. Four percent of the respondents reported extreme levels of fluid intake: either very low (up to 1 L a day; 4%) or very high (6.1–8 L a day; 4%) (Figure 2). Note: Two of the athletes (4%) did not know and one (2%) reported that they did not have any particular fluid intake patterns prior to their fights.

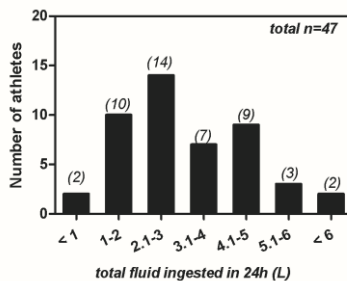


Figure 2: MMA athletes 24h fluid ingestion in the pre-competition period

The main rehydration fluid ingested by the athletes in the RWL period was water, followed by fresh fruit juices (22%), isotonic drinks (14%), non-carbonated soft drinks (12%), coconut water (10%), maltodextrin (6%), and "normal" fizzy drinks (2%) (Figure 3).

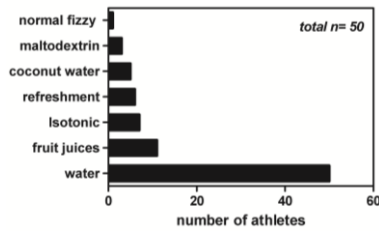


Figure 3: Type of fluids ingested by MMA athletes in the pre competitive period

The main nutritional strategies adopted by MMA athletes to achieve RWL, besides those already highlighted (figures 1-3), are shown in Table 1. A hypocaloric diet (86%), a gradual diet (80%), and water restriction (54%) were the most frequently reported strategies, followed by total fasting for 24 hours (40%) and skipping one or more meals (18%).

Table1: Nutritional strategy adopted by MMA athletes

Nutritional Strategy	Number of athletes	(%)
<i>hypocaloric diet</i>	43	86
<i>gradual diet</i>	40	80
<i>water restriction</i>	27	54
<i>total fasting</i>	20	40
<i>skipping one or more meals</i>	9	18

Table 2 presents data on the consumption of dietary supplements by MMA athletes during RWL. Only four (8%) of the fifty athletes reported not using any type of dietary supplement during this period. Twenty-eight reported using whey protein (56%) and 27 used branched chain amino acids (BCAA; 54%). The use of glutamine (36%), multivitamins (34%), Endurox (26%), beta alanine (26%), omega-3 (22%), and caffeine (22%) was also reported. The least consumed supplements were creatine (12%), carnitine (8%), bicarbonate (8%), followed by leucine, orthomolecular capsules, and albumin (4% each), as well as casein and medium-chain triglycerides (2% each). Seven athletes (14%) reported the consumption of other types of supplements.

Table 2: The consumption of dietary supplements by MMA athletes during Rapid Weight Loss.

Types of Supplement	Number of athletes	(%)
<i>Whey protein</i>	28	56
<i>BCAA</i>	27	54
<i>Glutamine</i>	18	36
<i>Multivitamins</i>	17	34
<i>Endurox</i>	13	26
<i>Beta Alanine</i>	13	26
<i>Caffeine</i>	11	22
<i>Omega-3</i>	11	22
<i>Creatine</i>	6	12
<i>Carnitine</i>	4	8
<i>Bicarbonate</i>	4	8
<i>Leucine</i>	2	4
<i>Orthomolecular capsules</i>	2	4
<i>Albumin</i>	2	4
<i>Casein</i>	1	2
<i>Medium-chain triglycerides (MCT)</i>	1	2
<i>Others</i>	7	14

The non-nutritional strategies reported by the respondents were wearing plastic clothing (70%), using dry or steam sauna (60%), engaging in longer training sessions (48%) or more intense training (44%), doing hot workouts (40%), and using immersion in hot water (38%). Just one athlete reported using weight-loss drugs (2%) and none reported using laxatives or diuretics (Table 3)

Table 3: The non-nutritional strategies used by MMA athletes during Rapid Weight Loss.

Strategy	Number of athletes	(%)
<i>Plastic clothing</i>	35	70
<i>Dry or Steam Sauna</i>	30	60
<i>High volume of training session</i>	24	48
<i>High intensity of training session</i>	22	44
<i>Training in a hot ambient</i>	20	40
<i>Immersion in hot water</i>	19	38
<i>Drugs to weight loss</i>	1	2
<i>Laxatives and diuretics drugs</i>	0	0

DISCUSSION

The nutritional strategies most used by MMA athletes to achieve RWL were the adoption of a low-calorie diet (86%), a gradual diet (80%), water restriction (54%), total fasting for 24 hours, and the use of sports supplements. In a study of 30 MMA athletes, Crighton et al. (2016) found a significant reduction in carbohydrate intake and use of total fasting for 24 hours by 100% of the respondents during the last 3–5 days prior to the official weigh-in. Energy restriction may result in an inadequate supply of macro- and micronutrients important for body homeostasis, resulting in the loss of lean body mass, which is associated with a higher incidence of hormonal disorders and a higher frequency of infectious diseases, as well as a subsequent impairment of training and changes in the athlete's physical performance (ADA, 2016).

Reduced energy intake was more common than fluid restriction. Significantly restricting energy intake by reducing the consumption of carbohydrate-rich foods for days in preparation for combat can induce major physical debilitation. Lambert & Jones (2010) argue that tapering is more effective than RWL and should be encouraged among athletes. Restricting food 24–48 hours before the official weigh-in may be necessary in some cases to decrease fecal volume, which also contributes to total body mass. Unfortunately, there are also reports of abuse of laxatives and diuretics prior to weigh-ins, which are banned by the WADA (Mendes et al., 2013, WADA, 2018).

It could be that modulating water intake could be more effective than reduced energy consumption for achieving the desired body weight reduction. In fact, for athletes whose body fat is at ideal levels at the beginning of RWL, dehydration could be the determining factor for its effectiveness. In fact, 54% of the athletes in our study reported restricting fluid intake during the pre-fight period. However, this was normally between 12 and 24h prior to the official weigh-in, and its magnitude varied according to the amount of body mass yet to be lost. During the days preceding the event, except for the final 12 to 24 hours before weigh-in, most athletes did not restrict their water intake significantly, but they did arrive at the weigh-in severely

dehydrated and thirsty. Figure 1 shows that 84% of the athletes hydrated in the pre-fight period and Figure 2 shows that 60% of the athletes ingested 2.1 to 5L fluids per day during this time, while some consumed up to 6 L (6%) or 8 L (4%) a day.

Therefore, the athletes' hydration habits were split into two different moments during RWL: hyperhydration (water loading) in the initial days and intense dehydration from 12 to 24 hours before the official weigh-in. Interestingly, the fluid used by all the athletes at that time was water. Only 5 (10%) athletes reported hydrating "almost never" during the pre-competitive period and one (2%) reported never hydrating in this period. There were also two athletes who reported ingesting up to 1 L (4%) and two who failed to respond (4%), while one (2%) reported no fluid intake pattern. Similarly, Crighton B. et al. (2016) found 67% of the MMA athletes studied engaged in water loading, consuming 20–23 L water and restricting sodium intake over a period of three days prior to competition. Acute hyperhydration can result in electrolyte imbalances due to a changes in the concentrations of extracellular solutes (e.g., sodium), which induce hyponatremia, inducing nausea, headaches, cramps, confusion, drowsiness, behavioral disorders, convulsion, and eventually coma (Marins et al., 2000).

Another aspect of RWL is the use of food supplements. In normal situations, supplements are recommended when athletes do not meet their daily vitamin, mineral, and energy requirements (Misner B, 2006; Maughan et al, 2007). However, the consumption by elite athletes is often designed to improve performance or speed up post-exercise recovery. An alternative would be to follow nutritional counseling to improve their dietary intake, especially during RWL, through appropriate food group choices. Sixty-two percent of the athletes reported using at least one type of dietary supplement, primarily whey protein (62%), BCAAs (60%), and glutamine (40%), which is suggestive of a quantitative reduction in carbohydrate intake. A study by Vieira and Biesek (2015) found a lower consumption of supplements by fighters of other martial arts (JUDO, JIU-JITSU, and MUAY THAI) than was encountered in this study of MMA athletes. They found that 57% of the athletes did not use any dietary supplement, but 43% used one or more substances. None

reported using laxatives or diuretics, perhaps because their use is regarded as doping by the World Anti-Doping Agency (WADA, 2018). Andreato et al. (2014), in a study of eight MMA athletes, reported that 37.5% used diuretics and 12.5% used "pill" supplements during RWL.

The most frequently reported non-nutritional strategies in our study were plastic clothing (70%), dry or steam saunas (60%), and longer training sessions (48%). Matthews & Nicholas (2017) found that MMA athletes were severely dehydrated at official weigh-ins, using saunas (43%) and training in plastic suits (43%) to lose water. Andreato et al. (2014) present similar findings, with athletes exercising in the heat (50%), restricting calorie and fluid intake (37.5%), and using saunas (37.5%). Silva (2014) found an even higher incidence of the use of saunas and plastic clothing (90%), as well as a more intense training regimen (50%). Weight loss strategies are commonly employed by athletes from different combat sports. Barley et al. (2017) found that skipping meals was more prevalent in taekwondo and wrestling (84%) than in other combat sports (~58%); training in hot rooms (83%) and forced dehydration (47%) were more common in wrestling than in other combat sports (~45% and ~19%, respectively); and MMA athletes were more prone to use sauna (76%), water loading (67%), and training in plastic suits (63%). A greater magnitude of weight loss was found amongst the MMA athletes than the competitors of the other combat sports.

The use of plastic clothing associated with or without water restriction and/or long/intense training in hot places imposes great stress on the cardiorespiratory, muscular, and thermoregulatory mechanisms and may induce hyperthermia, cramps, generalized weakness, fatigue, nausea, diarrhea (Marins et al., 2000), and even death (Karila et al., 2008).

It has been well documented in the literature that RWL is injurious to athletes, causing metabolic and physiological disorders such as reduced muscle strength, decreased performance time, hormonal imbalance (e.g., testosterone-cortisol), immunosuppression, altered cardiovascular system, decrease in muscle glycogen content, hydroelectrolytic imbalance, reduction of lean mass, disturbances in renal function, and retardation in the growth and development of adolescent athletes (Fabrini, 2006). In addition to physiological

damage RWL can affect athletes' mental health, resulting in poor performance during combat (ADA, 2016). However, there are authors (Pettersson et al., 2013) who have found that weight loss may actually enhance athletes' mental powers. Meanwhile, others (Andreato et al., 2014) have found no apparent change in the mood (levels of tension, depression, anger, vigor, fatigue, and confusion) of professional MMA athletes at the official weigh-in and shortly before combat.

Interestingly, many athletes who engage in RWL are still unable to reach the target body mass for their weight division at the weigh-in. This suggests that a high proportion of athletes fight under inappropriate conditions, even after a 24- to 36-hour recovery period. The loss of up to 5% of body mass during the pre-competition week with a subsequent recovery period of only 4 hours in combat athletes (e.g., judokas) does not impair performance and does not lead to the deleterious effects that have been described for RWL. However, these data should not be extrapolated to inexperienced athletes (Artioli et al., 2010; Mendes et al., 2013). Artioli et al. (2010) found a high prevalence of weight loss of up to 5% of body mass over seven-day periods in judo. They evaluated 822 competitive judokas, excluding the "heavyweight" category, and found an incidence of weight loss of 89%. Official weigh-ins closer to the combat time appear to induce healthier practices, discouraging RWL among athletes.

The lack of consensus about safe nutritional and non-nutritional behaviors designed to reduce weight before competition indicates the importance of studies like the one reported on here. To avoid health risks, no more than 2% of body mass should be lost per week, thus delaying the metabolic and physiological changes resulting from this process (ADA, 2016). However, the prevalence of RWL remains high among combat sports. Changing the rules so as to discourage such strategies would be an ideal preliminary measure to reduce the incidence of RWL in athletes. Little has been done in this regard. Recently, the largest MMA event in the world, the UFC, banned venous rehydration after weigh-ins. This should discourage extreme RWL strategies, in which athletes depend on intravenous rehydration to recover their lost body mass. With the prohibition of this technique, athletes have to attenuate the reduction of their pre-fight body mass. Considering that this is a relatively new rule, little

has yet been done to curb the use of such strategies in sport. In August of 2017, the Brazilian Athletic Commission of MMA (CABMMA) published a ten-point plan against extreme weight loss in MMA, describing the measures that may be adopted in order to guarantee the health and safety of professional athletes.

What is generally perceived is that the UFC, like other companies in sports and other areas, focuses primarily on profit, not the health of its athletes. Matthews & Nicholas (2017) argue that the rules should change and Artioli et al. (2016) go further, arguing that RWL should be considered doping and thus be banned from sport. However, until the time of writing, RWL continues to be a licit strategy. Whether or not to engage in it is a personal decision taken by individual athletes. MMA is the profession of these individuals, who are highly dedicated to the sport and who are arguably coerced to use RWL to be able to compete at the highest level.

Traditional models of dietary planning are not sufficient to meet the great demand for reduced body mass achievable by RWL, especially in athletes who already have a low BMI. The involvement of nutritionists is fundamental in the planning and execution of strategies that in fact oppose the empiricism of the extreme practices adopted by MMA athletes, enabling sporting practices with appropriate nutritional management. Knowledge about the techniques used to manipulate body mass is helpful for devising strategies that minimize the health risks of MMA athletes. Additionally, periodic campaigns could be run to raise awareness amongst the individuals who lead the sport and amongst athletes themselves, so that they can come together and push for changes in the rules. Prior knowledge of the main nutritional and non-nutritional strategies adopted in RWL is fundamental for professionals who work with these sportspersons, as it helps guide their behavior during this critical period of preparation of the athlete.

Practical Applications

In the present study, an adapted questionnaire was applied to MMA athletes who underwent rapid weight loss strategies through nutritional and non-nutritional methods (Artioli et al., 2010). Among athletes combat, MMA athletes are those who submit to a greater

magnitude of body weight loss which imposes health risks to athletes (Barley et al., 2017). It is noteworthy that no athlete likes to submit to the RWL. In that sense, a perspective for the sport would be to ban such practice. According to Artioli et al.,(2016) the RWL meets all the doping criteria adopted by the World-Doping Agency Code (WADA). Understanding RWL strategies and their associated risks are essential to raise awareness of athletes, teams and event organizers and banish weight loss from sports.

CONCLUSION

To achieve their desired weight for weigh-ins prior to competition, MMA athletes prefer the following rapid weight loss strategies: a low-calorie diet, a gradual diet, water restriction, wearing rubber or plastic clothing, and using dry or steam saunas. Athletes who engage in RWL are not exempt from possible negative effects on the health and performance in the short, medium, and long term. Although it is not against the rules, RWL is harmful to athletes, and should be banned from the sport. Until this scenario changes, health professionals and the entire team involved in MMA must develop strategies to minimize the damage resulting from rapid weight loss.

REFERENCES

1. Andreato L.V, Andreato T.V, Santos J.F.S, Esteves, J.V.D.C, Moraes S.M.F, Franchini E. Weight loss in mixed martial arts athletes. *Journal of Combat Sports and Martial Arts* 2014;5:125-131.
2. American college of sports medicine. Position stand: weight loss in wrestlers. *Medicine Science in Sports and Exercise* 1996;28:ix-xii.
3. American college of sport medicine. Academy of Nutrition and Dietetics Dietetians of Canadá. Special Communications 2016;48:543-568.
4. Artioli G.G, Franchini F, Lancha, J.A.H. Perda rápida de peso em esportes de combate de domínio: revisão e recomendações aplicadas. *Revista Brasileira de Cineantropometria & Desempenho Humano* 2006;8:91-101.
5. Artioli G.G, Iglesias R.T, Franchini E, Gualano B, Kashiwagura, D.B, Solis M.Y, Benatti F.B, Fuchs M, Lancha, J.A.H. Rapid weight loss followed by recovery time does not affect judo-related performance. *Journal of Sports Sciences* 2010;28:21-32.

6. Artioli G.G, Gualano B, Franchini E, Scagliusi, F.B, Takesian M, Fuchs M, Lancha J.A.H. Prevalence, Magnitude, and Methods of Rapid Weight Loss among Judo Competitors. *Medicine & Science in Sports & Exercise* 2010:436-442.
7. Artioli G.G, Saunders B, Iglesias R.T, Franchini E. It is time to Ban rapid weight loss from combat sports. *Sports Medicine* 2016;46:1579-1584.
8. CABMMA- Comissão Atlética Brasileira de MMA. www.cabmma.org.com.br (Acessado em 18/04/18).
9. Barley O.R, Chapman D.W, Abbiss C.R. Weight Loss Strategies in Combat Sports and Concerning Habits in Mixed Martial Arts. *International Journal of Sports Physiology and Performance* 2017;28:1-24.
10. Crighton B, Close G.L, & Morton J.P. Alarming weight cutting behaviours in mixed martial arts: a cause for concern and a call for action. *British Journal of Sports Medicine* 2016;50:446-447.
11. Fabrini S.P, Brito C.J, Mendes, E.L., Sabarense C.M, Marins, J.C.B, Franchini E. Práticas de redução de massa corporal em judocas nos períodos pré-competitivos. *Revista Brasileira de Educação Física e Esporte* 2010;24:165-77.
12. Jetton A.M, Lawrence M.M, Meucci M, Haines T.I, Tracie I, Collier S.R, Morris D.M, Utter A.C. Dehydration and acute weight gain in mixed martial arts fighters before competition. *Journal of Strength and Conditioning Research* 2013;27:1322-1326.
13. Karila T.M.A.P, Sarkkinen P, Marttinen M, Seppälä T, Mero A, Tallroth K. Rapid weight loss decreases serum testosterone. *International Journal of Sports Medicine* 2008;29:872-877.
14. Kiningham R.B, Gorenflo D.W. Weight loss methods of high school wrestlers. *Medicine & Science in Sports & Exercise* 2001;33:810-3.
15. Lambert C, Jones B. Alternatives to rapid weight loss US wrestling. *International Journal of Sports Medicine* 2010;8:523-528.
16. Marins J.C.B, Dantas E.H.M, Zamorra-Navarro S. Variaciones del sodio y potasio plasmáticos durante el ejercicio físico: factores asociados. *Educación Física y Deportes* 2000;4:48-55.
17. Maughan R.J, Depiesse F, Geyer H. The use of dietary supplements by athletes. *Journal of Sports Science* 2007;25:103-113.
18. Matthews J.J, Nicolas C. Extreme Rapid Weight Loss and Rapid Weight Gain Observed in UK Mixed Martial Arts Athletes Preparing for Competition. *International Journal of Sport Nutrition and Exercise Metabolism* 2017;27:122-129.
19. Mendes SH, Tritto AC, Guilherme JPLF, Solis MY, Vieira, DE, Franchini E, Lancha JA, Artioli AA. Effect of rapid weight loss on performance in combat sport male athletes: does adaptation to chronic weight cycling play a role? *British Journal of Sports Medicine* 2013;47:1155-1160.
20. Misner B. Food alone may not provide sufficient micronutrients for preventing deficiency. *Journal of the International Society of Sports Nutrition* 2006;3:51-55.
21. Pettersson S, Ekestrom PM, Berg MC. Practices of weight regulation among elite athletes in combat sports: A matter of mental advantage? *Journal of athletic training* 2013;48:99-108.

22. Silva JML, Gagliardo LC. Análise Sobre os Métodos e Estratégias de Perda de Peso em Atletas de Mixed Martial Arts (M.M.A.) Em Período Pré-Competitivo. *Revista Brasileira de Nutrição Esportiva* 2014;43:74-80.
23. Vieira ACS, Biesek S. Avaliação do consumo de recursos ergogênicos nutricionais por praticantes de artes marciais em uma academia da cidade de Curitiba-PR. *Revista Brasileira de Nutrição Esportiva* 2015;53:454-462.
24. World Anti-Doping Agency. World anti-doping agency code. International Standard 2018: www.wada-ama.org. Acessado em 15/01/18.
25. Yrfan Y. Associations among Dehydration, Testosterone and Stress Hormones in Terms of Body Weight Loss before Competition. *The American Journal of the Medical Sciences* 2015;350:103-108.