

# Weight loss in mixed martial arts athletes

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**Key words:** combat sports, blood lactate, weight loss, profile of mood states, osmolality

## Summary

**Introduction.** The aim of this study was to analyze the magnitude and methods of weight loss among MMA fighters and the influence of this practice in hydration and profile of mood state.

**Material and methods.** The sample was composed by eight MMA fighters during a professional MMA competition, but only five athletes finished all procedures. To evaluate the weight loss prevalence, magnitude and methods it was applied the *Rapid Weight Loss Questionnaire* adapted to MMA. Saliva samples were taken in the official weigh-in and one hour before of the combats to estimate the salivary osmolality. To evaluate the profile of mood states the Brunel Mood Scale (BRUMS) was applied.

**Results.** The results showed that all participants already had lost weight to take part in another event. The athletes reported that they always adopted as method to lose weight: to make more exercise (50 %) and reduce food intake of liquids (37.5 %). The dangers methods to health were cited by athletes in the following sequence: use of diuretics (37.5%), sauna (37.5%), training intentionally in heated training rooms (50 %) and use of diet pills (12.5%). In the competition analyzed 88% of athletes reduced their body mass ( $4.5 \pm 4.2$  kg,  $5.4 \pm 4.3$  %) to compete. The salivary osmolality did not show significant difference between weigh-in ( $55.6 \pm 30.7$  mOsmol/kg H<sub>2</sub>O) and pre-match moment ( $40.2 \pm 27.9$  mOsmol/kg H<sub>2</sub>O). The profile of mood states did not change between the weigh-in (tension:  $1.2 \pm 1.8$ , depression:  $0 \pm 0$ , anger:  $1.2 \pm 1.6$ , vigour:  $14.0 \pm 0.7$ , fatigue:  $2.6 \pm 5.3$ , confusion:  $0.2 \pm 0.4$ ) and the pre-match moment (tension:  $2.6 \pm 2.2$ , depression:  $0 \pm 0$ , anger:  $1.4 \pm 1.9$ , vigour:  $15.6 \pm 0.5$ , fatigue:  $0.0$ , confusion:  $2.8 \pm 3.9$ ).

**Conclusions.** The conclusion is that there is a great prevalence of weight loss in MMA athletes in this sample. Furthermore, dangers methods to health are or were practiced to reduce the body mass to compete.

## Introduction

The *mixed martial arts* (MMA) is among the sports with higher spectators increase in the world. This fact can be observed in growth of exposure on media and increased number of practitioners and spectators [1]. This sport is composed by combination of boxing, Muay Thai, karate, taekwondo, wrestling, Brazilian jiu-jitsu, judo and other disciplines specific techniques. Nowadays, the MMA is practiced in various countries being the sixth more popular sport in United States of America [2]. Despite the notoriety achieved, few studies aimed to investigate the different fields of this sport. Among the studies that have been conducted involving MMA, most focused on the injuries happened during combat [2-5].

In many sports, especially in combat sports, the athletes are divided according to body mass. This strategy is adopted

to leave the disputes more balanced. However, it is commonly observed that athletes conduct some arrangements to reduce large amounts of body mass to move to lighter categories, in an attempt to compete against smaller and weaker opponents [6]. In fact, there are data indicating that boxers [7,8], judokas [9,10], wrestlers [11], Brazilian jiu-jitsu athletes [9-12], taekwondo athletes [13,14] and karate athletes [9] adopt methods to reduce the body mass prior to a competition, but no study has been conducted involving the MMA.

This practice can be harmful, because it negatively alters the humor profile, sports performance and health, especially when the magnitude of reduced mass is high [6,15]. It is not difficult to find reports of combat sports athletes reducing a large percentage of body mass. For example, in university level Olympic wrestling ( $n = 63$ ), 89% of the athletes reported to be engaged in some procedure to reduce body mass prior

to competition, and 41% of the athletes reported weight fluctuations from 5.0 to 9.1 kg in an one week period [16].

Furthermore, attention should be given to the methods used. Accordingly, a large portion adopts rapid weight loss, using harmful methods such as dehydration, induced vomiting, fasting (not eating all day), exercise with rubber/plastic suits to increase sweating, sauna, diet pills, laxatives and diuretics [10]. Extreme cases are reported among combat sports athletes, like the death of three young North-American collegiate in the same period because dehydration and hyperthermia [17].

Given this scenario, proposals arise to inhibit such practices [18]. Those include reducing the interval between weighing and the first match [18]. Since the MMA presents weight categories and the time interval between the weighing and the combat is long, commonly between 24 and 48 hours, this study creates the possibility that athletes from this sport decreased their body mass due to the prolonged time of recovery, making use of one or more harmful methods to their health. Based on the theoretical framework presented prior, the aim of this case study was to analyze the magnitude and methods of weight loss among MMA fighters and the influence of this practice on hydration and profile of mood state in a real competition setting.

## Material and methods

### Experimental Approach to the Problem

The subjects were evaluated during a MMA professional competition period. The collected date happening in the first day, when the athletes participated in weighing and the salivary sample was obtained after the competitive day. The Brunel Mood Scale and saliva samples were collected during the official weigh-in, which occurred approximately 24 h before of the fights and 1 h before the combats. The *Rapid Weight Loss Questionnaire* was applied once after weighing.

### Sample

The sample was composed by eight MMA fighters (age:  $22 \pm 5$  years old, body mass:  $74.3 \pm 8.1$  kg, height:  $1.77 \pm 0.05$  m). They had  $7.4 \pm 5.1$  years of experience in combat sports, but only  $3.4 \pm 3.3$  years of regular and systematic practice in MMA and competed in this sport for  $2.3 \pm 2.8$  years, with experience in regional and national competitions. From the total sample, five subjects (age:  $23 \pm 6$  years old, body mass:  $76.9 \pm 7.7$  kg, height:  $1.79 \pm 0.03$  m) answered a Brunel Mood Scale and had their saliva collected during the official weigh-in, which occurred 24 h before the fights and 1 h before their combats. The data were collected during a professional MMA competition. All subjects were informed about the study procedures, and all signed consent forms. This study was approved by the local ethics committee and is in accordance with the declaration of Helsinki.

### Procedures

**Body mass.** For this variable the measure obtained during the official weigh-in, conducted in a portable balance, was

considered. The report given by the athletes was used to calculate the weight lost.

**Rapid Weight Loss Questionnaire (RWLQ).** To verify the magnitude and methods used to rapid weight loss a questionnaire developed and validated to judo was applied [19], after adaptation to MMA. The questionnaire contains 20 questions and is divided in three parts. In the first part the subjects are characterized, in the second part the prevalence and the magnitude to rapid weight loss are quantified, and in third part the methods more often used to lose weight by MMA athletes are described. With the aim of facilitate the comparison, it was assigned a score to responses so that the greater the score of the subject, more dangerous is their behavior for weight loss. The point system was previously described [19].

**Saliva collection and biochemical analysis.** Samples were collected using cotton to stimulate salivation, which was chewed for about 1 min. The saliva samples were centrifuged at 3.000 rpm (4°C, 15 minutes) and stored in Eppendorf tubes and frozen at -20°C until their analysis. The salivary osmolality was estimated by duplicate in Wescor Vapro 5520® osmometer.

**Profile of mood states.** To evaluate the profile of mood states of the athletes the Brunel Mood Scale (Brums) was applied [20].

### Statistical Analysis

The data were statistically analyzed using GraphPad 3.0® and SPSS 20® softwares and are presented as mean (M), standard deviation (SD), 95% confidence interval (CI 95%), range (minimum and maximal values) and frequency (%). Normality was accessed with the use of the *Kolmogorov-Smirnov* test. A comparison across the different time points was performed by conducting a *Student's t* test or *Wilcoxon* test depending on the normality or non-normality of the data, respectively. *Kruskal-Wallis* test followed by *Dunn post hoc* was used to compare the components of the profile of mood states (BRUMS).

To evaluate the magnitude of difference the *Cohen's* effect size was calculated. Threshold values to determine the effect size were  $<0.2$  (small),  $>0.2$  and  $<0.8$  (moderate) and  $>0.8$  (large) [21]. *Pearson's* or *Spearman's* correlations coefficients were calculated in order to study the relationship between weight loss, rapid weight loss questionnaire and osmolality, depending on the normality or non-normality of the data, respectively. The  $\alpha$  level was set previously at 5%.

## Results

All athletes already had reduced weight to previous competitions (Table 1). During the competition analyzed, seven athletes (88%) reduced the body mass to compete ( $4.5 \pm 4.2$  kg,  $5.4 \pm 4.3$  %).

The methods to weight loss reported by athletes are show in table 2. Among the methods utilized some are considered dangerous to health.

The figure 1 presents the salivary osmolality during the weighing and before MMA combats.

There was no statistical difference between weigh-in ( $55.6 \pm 30.7$  mOsmol/kg H<sub>2</sub>O) and pre-match ( $40.2 \pm 27.9$  mOsmol/

Tab. 1. Weight loss history reported by the mixed martial arts athletes (n=8)

	Mean ± SD	CI 95%	Range
Weight lost in relation to vacation of January (kg)	5.1 ± 5.4	0.6 – 9.6	+ 1.9 – - 13.0
Weight lost in relation to vacation of January (%)	6.6 ± 6.8	-12.3 – -0.9	- 15.6 – +2.7
Most weight lost (kg)	7.6 ± 4.7	3.7 – 11.5	2.0 – 15.0
Average weight usually lost (kg)	5.0 ± 3.3	2.0 – 8.0	2.0 – 10.0
No. weight reductions in the last year	2 ± 2	0 – 3	0 – 6
No. days in wich weight is usually lost	12 ± 13	0 – 24	2 – 40
Age that began cutting weight (years)	19 ± 3	16 – 22	16 – 25
Weight usually regained in the week after competitions (kg)	3.5 ± 2.3	1.4 – 5.6	1.5 – 8.0
Weight usually regained in the week after competitions (%)	4.4 ± 2.5	2.1 – 6.8	1.7 – 8,3
Score obtained in the <i>Rapid Weight Loss Questionnaire</i> (points)	35.1 ± 14.8	22.8 – 47.5	13.5 – 55.0

SD: standard deviation, CI 95%: confidence interval of 95%.

Tab. 2. Frequency analysis of the weight loss methods reported by the mixed martial arts fighters (n=8)

	Always	Sometimes	Almost Never	Never	Do Not Use Anymore
Gradual dieting	25.0	37.5	-	37.5	-
Skipping one or two meals	12.5	50.0	-	37.5	-
Fasting	25.0	25.0	12.5	25.0	12.5
Restricting fluids	37.5	12.5	25.0	25.0	-
Increased exercise	50.0	37.5	12.5	-	-
Heated training rooms	12.5	50.0	-	37.5	-
Sauna	12.5	37.5	-	50.0	-
Training with rubber/plastic suits	12.5	25.0	37.5	12.5	12.5
Using winter or plastic suits	12.5	-	25.0	62.5	-
Spitting	25.0	37.5	12.5	25.0	-
Laxatives	-	-	12.5	75.0	12.5
Diuretics	-	37.5	12.5	50.0	-
Diet pills	-	12.5	-	87.5	-
Vomiting	-	-	-	100	-

Values expressed in percentage (%).

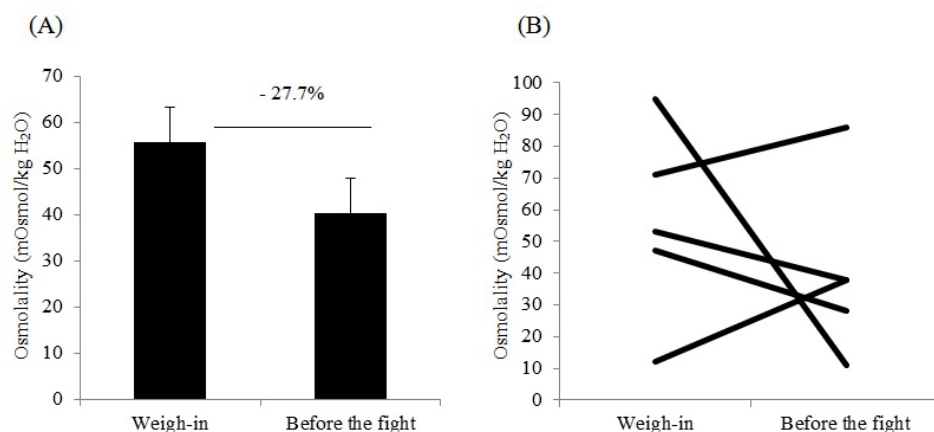


Fig. 1. Grouped (panel A) and individual (panel B) salivary osmolality responses during weight-in and one hour before the mixed martial arts competition (n=5)

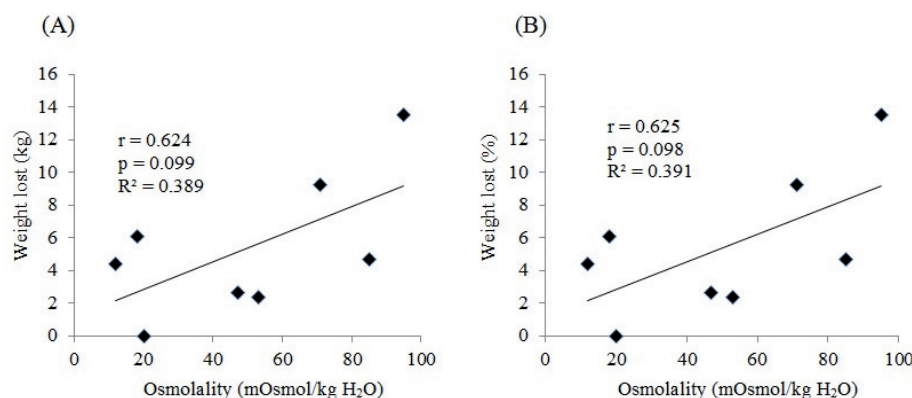


Fig. 2. Correlations ( $n = 8$ ) between absolute weight lost (kg) and salivary osmolality (mOsmol/kg H<sub>2</sub>O) (panel A) and relative weight lost (%) and salivary osmolality (mOsmol/kg H<sub>2</sub>O) (panel B)

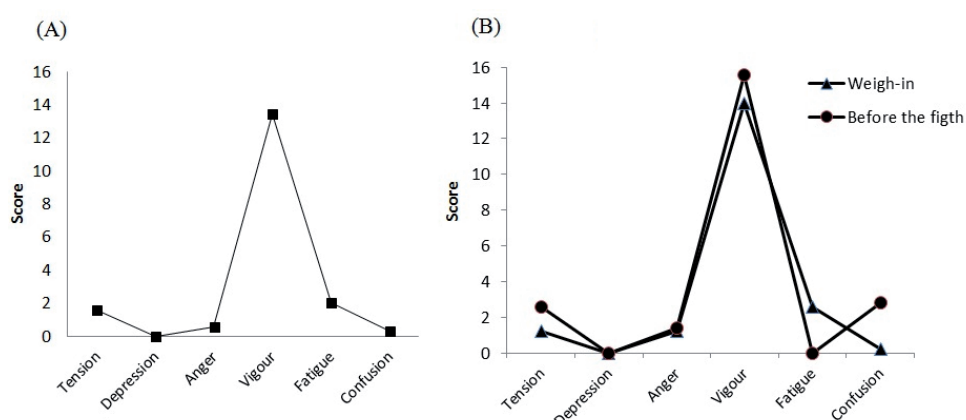


Fig. 3. Profile of mood of mixed martial arts athletes ( $n = 5$ ) during the weighing ( $n = 8$ ; panel A) and (B) during the weighing and before match (panel B)

kg H<sub>2</sub>O) ( $t = 0.80$ ,  $p = 0.47$ , effect size = 0.53), probably because a high variation was observed among the athletes investigated.

The figure 2 presents the correlation between absolute (kg) and relative (%) weight loss with the salivary osmolality (mOsmol/kg H<sub>2</sub>O).

The correlation between osmolality and weight loss was not significant for both absolute and relative weight lost.

The figure 3 presents the profile of mood of MMA athletes during official weighing before competition.

Concerning the profile of mood during the weighing, the athletes presented higher scores for vigor than for tension ( $p < 0.05$ ), depression ( $p < 0.001$ ) and angry ( $p < 0.05$ ). The athletes presented the “iceberg” profile with higher values in tension. No significant difference was found between weigh-in (tension:  $1.2 \pm 1.8$ , depression:  $0 \pm 0$ , anger:  $1.2 \pm 1.6$ , vigour:  $14.0 \pm 0.7$ , fatigue:  $2.6 \pm 5.3$ , confusion:  $0.2 \pm 0.4$ ) and pre-match (tension:  $2.6 \pm 2.2$ , depression:  $0 \pm 0$ , anger:  $1.4 \pm 1.9$ , vigour:  $15.6 \pm 0.5$ , fatigue:  $0.0$ , confusion:  $2.8 \pm 3.9$ ). No correlations were found between profile of mood and weigh loss.

## Discussion

The results indicated that all professional MMA athletes taking part in this competition already reduced their body

mass to compete, while seven athletes (88%) did the same for this competition. However, the salivary osmolality showed no significant difference between the weight and pre-match, probably because there was a high variation in the response for the different athletes or because the time between weighing and competition was long enough for recovery of this variable. The profile of mood did not change between the time of weighing and pre-match. The methods used predominantly among athletes was to increase the amount of exercise and reduce the liquid ingest. Different harmful methods to health were cited by athletes, whose the following were the most reported: taking diuretics, staying in saunas, training intentionally in heated training rooms and taking diet pills.

Although our sample was quite small, the percentage of athletes reducing body mass observed in this study was similar to that described by Steen e Brownell [16], in research with American college wrestlers ( $n = 63$ ), in which it was pointed out that 89% of athletes already reduced body mass. In judo, research conducted with 607 men and 215 women reported that 86% of the sample had reduced body mass to compete, and when heavyweight category (category no weight limit, >100kg) was excluded this percentage rose to 89% [10].

One of possible cause that encourage athletes to reduce their body mass is the relatively long time between the weigh-

ing and the combat. To inhibit this practice a simple organizational action is to reduce this time interval [18]. In a fact, the recovery time between the weighing and competition is relatively long in many combat sports. In judo, during state competition the interval varied between 2.5 to 5 hour [22] and in taekwondo between 16 to 20 hours [13]. In MMA, although there are no surveys published, it is observed that the intervals are typically between 24 to 48 hours.

This hypothesis that the decreased recovery interval time can inhibit the practice of weight loss among athletes can be sustained given the data obtained in one study conducted with 120 (14 women and 106 men) Brazilian jiu-jitsu athletes Brazilian, in which the weight loss prevalence reported was only 29% [23]. However, subsequent research has found that among national and international level athletes the prevalence was higher (50%), while for regional level Brazilian jiu-jitsu athletes it was 62.5% [9]. This prevalence presented by Brazilian jiu-jitsu is lower than previously reported in other combat sports, probably because the time interval between weigh in and competition is shorter in Brazilian jiu-jitsu. In taekwondo it was evidenced that adolescent athletes recovered 1kg between the weighing and the start to combats, which ranged from 16 to 20 hours [13]. However, when the recovery time after weighing is long, the deleterious effects from weight loss in performance appear to be deleted [24,25].

In this study, it was observed a  $5.4 \pm 4.3\%$  body mass' reduction. These results are slightly higher than observed in judo, where the athletes reduce  $2.5 \pm 2.3\%$ , although it has been reported reductions of up to 16% of body mass [10]. However, these results are similar to the 5.0 to 9.1 kg reduction during one week period in wrestlers [16].

The subjects of this study started the process for rapid weight loss 12 days before the start of competition. This reduction process was longer than reported among athletes of other grappling sports such as judo, in which athletes have reduced most of their body mass in one week [10]. It is known that the rapid weight loss tends to be detrimental to performance and health [6,26].

The average age that the athletes of this study started the weight loss practice to competition was approximately 19 years. However, it has been related in the literature that in many combat sports the athletes begin this practice earlier in their careers. In judo, approximately 60% of the athletes began to lose weight between 12 and 15 years [10]. A similar trend was observed in wrestlers [11], who started to lose weight at  $15.5 \pm 2.4$  years. The age when the weight loss practice is initiated is an important factor to be considered, because sooner the athletes begin this practice more they tend to adopt more dangerous methods when adults [10], and these practices during adolescence can negatively affect athlete's growth and development [27].

Among the methods adopted by MMA athletes we found increased exercise practice and reduced liquid ingestion. Other harmful methods to health were mentioned, because the athletes sometimes take diuretics, stay long periods in

sauna, train in heated rooms and take diet pills. All these methods can result in hypohydration and were mentioned by the subjects who took part in our research.

Corroborating with the present research, a study with over 400 wrestling practitioners reported that dangerous methods to lose weight, including restricting fluids ingestion, food restriction, use of laxatives and diuretics, were also observed [16]. These results are similar to those observed among boxers that tend to reduce the weight at the expense of restricting fluid and food intake in the week before competition [7].

Additionally, the practice observed to lose weight and consequently the dehydration affects directly the physical capacity of athletes [28], presenting reduction in capacity of redistribution of blood flux to periphery, lower hypothalamic sensibility to sweating and lower aerobic capacity to a debt heart determined [29,30]. Additionally, in combat sports can occur a rapid increase of body mass after weighing [31], fact this that can generate a state of overhydration. This state of overhydration can be detrimental to performance, since it can cause gastric discomfort and lead to hyponatremia [32,33].

Several methods are used to measure body dehydration, including bioelectrical impedance, plasma osmolality, urine tests, among others [34]. Many studies have pointed out that the salivary osmolality as a good method to identify the hydration status, especially because it is noninvasive and presents strong correlation with plasma osmolality [35,36]. In the present case study no significant change was found, but a high variability was observed among the athletes.

Although previous studies have pointed out the negative effect of rapid weight loss on mood [37,38], in the present study there was no difference in humor profile components (tension, depression, anger, vigour, fatigue and confusion) between the weighing and one hour pre-match moments.

## Conclusions

1. The conclusion is that there is a great prevalence of weight loss in MMA athletes in this sample. Furthermore, dangers methods to health are or were practiced to reduce the body mass to compete.
2. Although this case study brings some evidence concerning the harmful methods used by MMA athletes during the rapid weight loss process, new research are needed to confirm this behavior, especially with a large number of subjects. Furthermore, studies comparing athletes from different competitive levels may help to better understand the effects of this process on the competitive performance.

## Acknowledgements

The researchers Leonardo Vidal Andreato and Jonatas Ferreira da Silva Santos thank the CNPq agency for their scholarship. The researcher João Victor Del Conti Esteves thanks the FAPESP agency for his scholarship.

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Received: 17.04.2014

Accepted: 21.12.2014