

Research Article

**BODY WEIGHT AND MOOD STATE MODIFICATIONS IN MIXED
MARTIAL ARTS: AN EXPLORATORY PILOT**

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Body weight, mood states and Mixed Martial Arts

ABSTRACT

Mixed Martial Arts (MMA) fighters typically use Rapid weight loss as a strategy to make competition weight. The aim of the present study was to compare changes body weight and mood in professional male MMA athletes who used strategies to rapidly lose weight (n = 9) and with MMA athletes who did not (n = 3). Body Mass and mood states of Anger, Confusion, Depression, Fatigue, Tension and Vigor and Total Mood Disturbance were assessed 1) 30-days before competition, 2) at the official weigh-in 1 day before competition; 3) 10 min before competition, and 4) 10 minutes post-competition. Results indicated that Rapid Weight Loss associated with reporting higher Confusion and greater Total Mood Disturbance during at each assessment point. Rapid weight loss also associated with high Anger at the official weigh-in. However, in terms of performance, rapid weight loss did not have deleterious effects on performance. Research supports the notion that rapid weight associates with potentially dysfunctional mood states, but because rapid weight loss in MMA is so common, it is likely that both fighters rapidly lost weight. Future research needs to compare rapid weight loss in participants where one has used rapid weight loss strategies and the other fighter has not.

Keywords: *Body Weight, Mood States, Mixed Martial Arts, Weight Loss, Emotion*

INTRODUCTION

Mixed Martial Arts (MMA) competition spans ten weight divisions (27) and fighters often engage in strategies to reduce as high as 10% body weight in the 2-3 days prior to weigh-in (10, 11, 15, 20, 35). Weight-making strategies include intentional hypohydration (33), starvation (4), exercising in plastic/rubber suits, saunas and fluid intake restriction (32). Despite the severity of such strategies, fighters hold positive beliefs that weight can be replaced following the weigh-in and the fighter will have a weight advantage over her or his opponent in competition (15).

Wide scale usage of rapid weight loss strategies should be seen in context of evidence that shows they impair physical capacity for performance. Impaired performance occurs via factors associated with moderate dehydration which can impair muscular endurance during high-intensity exercise (19). Dangerous dehydration can result in a reduction of plasma volume, stroke volume, an increase in heart rate, and reduced arteriovenous oxygen difference during submaximal workouts (17). These modifications can affect renal flow and electrolyte abnormalities, and athletes who use rapid weight making strategies are vulnerable to heat injury and muscle cramps (34). Usage of rapid weight making strategies can also have negative health consequences (4) including acute effects on hormonal changes, growth impairment, poor bone formation, and reduced basal metabolic rate (2, 30, 34). Rapid weight loss is also associated with negative feelings such as increased anger, confusion, depression, fatigue and tension (15). Mood and emotions are commonly regarded as an important pre-competitive indicator of performance in competition (5, 14, 21, 22). A positive mood profile is

proposed to assist positive management of thoughts, feelings, and behaviors before and during competition (7, 22).

Despite these negative findings, not all research has been so clear-cut. From a study of 28 well-trained combat athletes (wrestling, boxing, judo, taekwondo, and karate athletes), Reljic et al. (36) reported no significant change in aerobic performance capacity in the rapid weight loss group when compared to a control group. Hall and Lane (15) found no significant difference in performance between competition and normal weight in a sample of competitive boxers.

It should be noted that little is known about the mood in MMA fighters. To address this gap in the research, the present study set out to explore changes in mood states and body weight in MMA fighters over the month leading up to competition and then investigate the association with rapid weight loss and performance. We argue the first step should be an exploratory study to explore mood and body weight at different points in time leading to competition. A study about mood state and body weight modifications in MMA will inform future research and practice on the most appropriate research design and data-collection methods to follow. Mood is transient in nature and pre-competitive mood is influenced by a variety of factors including features of the pre-competitive period (e.g., the surrounding environment). On the day of competition, the quality of the opponent could have a significant influence on the mood state of the fighter. Competing against an unknown opponent but one with a better ranking could exacerbate any personal concerns that the player might have (7). It is argued that the mood states of athletes going into competition could influence performance. For example, during four to five minutes per round, it is proposed that intense emotional

arousal such as feeling vigorous could help fighter's decision-making speed (28). Fast decision making should enhance full contact striking skills, grappling actions, submissions, chokes and joint locking techniques (29).

Even though there is widespread acknowledgment of the significance of mood states in sports performance (5) and overall health (1), relatively little is known about the emotional patterns of MMA participants during training programs, especially before, during and after rapid weight loss. Although evidence suggested the importance of getting adequate weight loss and mood states for enhancing performance during training moments and championships, there is not yet a study about the relationship between rapid weight loss and mood states in MMA athletes. In the present study, we offer hypotheses that propose that using rapid weight loss strategies will be associated with a negative mood state. We expect to see the largest differences at the weigh-in, a point that should capture extreme weight-loss and when the quality of the opponent is known. Therefore, the aim of the present study was to compare four moments during body weight modifications (30 days, 1 day and 10 minutes before the bout and after bout; 24h before the bout) in professional MMA fighters.

METHODS

Experimental Approach to the Problem

Data were collected at four points in time. Firstly, 30 days before the competition. Second, at the "Official weigh-in" which is held 24 hours before the fight. Third, 10 minutes pre-competition, and fourth 10 minutes post-competition (Figure 1).

*** Figure 1 near here***

Subjects

The sample was composed by 12 professional male MMA athletes (age range = 16–42 years) separated in RWL group (9 fighters: 25.6 ± 4.5 years, height = 1.72 ± 0.04 m, body mass = 77.8 ± 7.1 kg) and NWL group (3 fighters: 30.7 ± 13.3 years, height = 1.74 ± 0.09 m, body mass = 80.0 ± 5.2 kg), belonging to the Mato Grosso State in Brazil, during competition period of 2015. All participants had experience in national-level MMA tournament, competing in the last season before the experiment. As performance could influence mood (22), an inclusion criterion was established where each participant had won his previous contest (31), be ranked in the top 30 for his country, and to have less than 1 year of period within the contests. Exclusion criteria included not using athletes who were disqualified, and “no contest” (doping cases). The ethics Committee from the University of the first author approved the protocol of the study before the commencement of the assessments. Each participant signed an informed consent before taking part in the study.

Procedures

Training Sessions

Participants were training regularly (technical and tactical) two times/day 10 times/week (five MMA sessions and five Conditioning and Strength Training) during the

evaluation period. Each MMA session was composed by 15 min of warm-up, 15 min of technical training, 60 minutes of technical-tactical training and/or simulated contest, resulting in a combined time totaling 90 minutes of exercise. *Conditioning and strength training were composed by 60 minutes of MMA actions, weight training, Olympic lifts and variations. Strength endurance training was composed by repeated contractions under conditions of fatigue, with more than 15 repetitions with light loading (30 to 60% of 1 RM). Power training was composed by fast power full MMA movements, which required medium number of sequential actions (6 to 10 rep.) with medium to heavy loading (70 to 80 % of 1 RM). Maximum strength sessions with low number of repetitions (1 to 5 rep.) with heavy loads (80 to 100% of 1 RM) were realized in less quantity.*

Rapid Weight Loss Strategies

A strategic water consumption method was used where fighters manipulate water and sodium levels, maintain a carb intake of lower than 50 grams/day. They wore warmer clothes during training and, one day before to the weigh-in, hot baths and sauna to sweat in order to lose weight.

Measures

This is an exploratory pilot study that used a longitudinal with retrospective design. The body mass measured with the use Filizola[®] weighing scales accurate to 0.1kg. Mood states were assessed using the Brunel Mood Scale (39, 40). The BRUMS has been translated into Portuguese and validated in a Brazilian population by Rohlfs et al. (37). The instrument comprises 24 items rated on a five-point scale ranging from 0

(not at all) to 4 (extremely). The standard reference time frame used is a 'how do you feel right now'.

The BRUMS comprises six subscales (tension, depression, anger, vigor, fatigue, confusion), each consisting of four mood descriptors. Each subscale is scored from 0 to 16. Internal consistency values (Cronbach's alpha) for each of the six subscales and for the entire combined scale were all greater than 0.76 in the study by Rohlfs et al. (37). In terms of the nature of each mood state (22,39):

- Tension – defined by feeling nervous, anxious, panicky and worried. It should be noted that this might not be high directly observed musculoskeletal tension.
- Depression – defined by feeling dejected, downhearted, unhappy and miserable is. depressed mood rather than a clinical state of depression.
- Anger – defined as feeling annoyed, angry, bad-tempered and bitter.
- Vigor factor – defined as feeling active, lively, energetic, and alert.
- Fatigue – defined as feeling sleepy, exhausted, tired, and worn-out.
- Confusion – defined as feeling mixed-up, uncertain, confused, and muddled.

In addition, it is possible to obtain a single measure of mood disturbance by summing scores for negative mood scales and subtracting this score from vigor (TMD = vigor – (anger + confusion + depression + fatigue + tension). In the present study, the internal consistency of the total scale was 0.83, while those of the factors were as follows: anger, $\alpha = 0.63$; confusion, $\alpha = 0.63$; depression, $\alpha = 0.65$; fatigue, $\alpha = 0.61$; tension, $\alpha = 0.64$; and vigour, $\alpha = 0.82$. Alpha coefficients should be greater than .70, although the alpha coefficient is influenced by the number of items, an observation that helps explain why the alpha coefficient for all 24-items was deemed

acceptable. Low alpha coefficients represent a source of concern. Although the BRUMS has been the focus of numerous validation studies (40), it suggests that further work is needed. Recent research examining changes in emotion has used a single item to assess each concept (22), an argument that brevity in some contexts might be preferable over attempts to gain acceptable alpha values. It is noted that the inter-item reliability in the current investigation may limit extrapolation of the results.

Statistical Analysis

Data are presented as means, standard deviations or interquartile range. Prior to analysis, the normality of all variables was evaluated using Shapiro-Wilk test. Depending on the normality or non-normality of data distribution, a comparison across the different time was performed by two way ANOVA repeated measures [(Training moment x Weight-in) (RWL x NWL)] with Bonferroni post-hoc tests or Friedman test with Mann–Whitney U-test. To allow a better interpretation of the results, the effect sizes were calculated (eta squared η^2). Effect sizes for non-parametric analysis was calculated, defined as $ES = Z/\sqrt{N}$, where ES represents the effect size, Z is derived from the conversion of Mann-Whitney U test and N is the total number of observations. To interpret the resulting eta squared effect size, present study classified η^2 : < 0.1 = trivial effect, $0.1 \leq$ and < 0.2 = small effect, $0.2 \leq$ and < 0.5 = moderate effect and > 0.5 = large difference effect (6). The 95% confidence intervals were calculated and a significance level of $P \leq 0.05$ was used for all analysis. All statistical analyses were carried out using the statistics package for social science (SPSS Inc., Chicago, IL, USA, version. 20.0).

RESULTS

MMA athletes who rapid weight loss strategies reported reduced body weight significantly by 11.6 ± 3.5 kg during 30 days. Participants weighed 77.8 ± 7.1 kg at the weigh-in 30 days before competition and 66.2 ± 7.2 kg (Figure 2) at the official weigh-in.

***** Figure 2 near here*****

A significant interaction effect for changes in bodyweight over time between groups ($F_{1,10}=33.989$; $p \leq 0.001$; $\eta^2=0.77$) indicated that the RWL group during Training moment demonstrated higher body mass value than in Official Weight-in ($p \leq 0.001$; 95% CI=8.890; 14.221). However, there was no significant difference observed in NWL group between Training and Official Weight-in moments ($p=0.42$; 95% CI=-2.202; 3.535). The NWL group showed higher body mass value than RWL group during Official Weight-in ($p=0.015$; 95% CI=13.111; 4.453).

In terms of performance, 10 athletes won their fights (83.3%) and the victory by finishing was the most common ($n = 7 / 58.3\%$), also winning by technical knockout ($n = 2/16\%$) and one (8.3%) victory by decision of the arbitration. Among those who lost ($n = 2 / 16.7\%$) one was by arbitration decision and another by knockout. There was no significant difference in the mood assessed between the athletes who won and those who lost the match ($p > 0.05$ for all).

Table 1 showed the descriptive analysis of mood states in MMA fighters throughout different assessment points. In terms of differences in mood, the RWL group

reported higher scores for Confusion ($X^2=8.081$, $p=0.044$, $df=3$). The RWL group reported higher values than Official Weigh-in ($p=0.047$, $ES=0.16$) and before competition ($p=0.016$, $ES=0.20$). Results for Total Mood Disturbance ($X^2=14.461$, $p=0.002$, $df=3$) indicated that the RWL reported lower values at 30-days before competition, at the Official Weigh-in ($p=0.008$, $ES=0.22$), Pre-bout ($p=0.008$, $ES=0.22$) and after competition ($p=0.011$, $ES=0.21$). No effects were observed in NRWL within comparisons of Anger ($p=0.41$), Confusion ($p=0.19$), Depression ($p=0.39$), Fatigue ($p=0.43$), Tension ($p=0.24$), Vigor ($p=0.56$) and Total Mood Disturbance ($p=0.12$). No effects were observed in RWL within comparisons of Anger ($p=0.24$), Depression ($p=0.19$), Fatigue ($p=0.22$), Tension ($p=0.15$) and Vigor ($p=0.25$).

At the assessment 30-days from competition, results show no effects for NRWL and RWL in terms of comparisons of Anger ($p=0.48$), Confusion ($p=0.86$), Depression ($p=0.86$), Fatigue ($p=0.86$), Tension ($p=0.48$), Vigor ($p=0.86$) and Total Mood Disturbance ($p=0.48$). This trend was consistent for data collection at the Official Weigh-in (Confusion, $p=0.28$, Depression, $p=1.00$, Fatigue, $p=0.48$, Tension, $p=0.37$, Vigor, $p=0.28$ and Total Mood Disturbance, $p=0.21$), and before competition (Anger, $p=0.60$, Confusion, $p=0.86$, Depression, $p=1.00$, Fatigue, $p=1.00$, Tension, $p=0.21$, Vigor, $p=0.86$, and Total Mood Disturbance, $p=0.37$). Before competition, there were no effects NRWL and RWL comparisons of Anger ($p=0.86$), Confusion ($p=0.48$), Depression ($p=0.60$), Fatigue ($p=0.86$), Tension ($p=0.48$), Vigor ($p=0.28$) and Total Mood Disturbance ($p=0.86$).

***** Table 1 near here *****

Regarding the weight of the athletes in training, in the periods of 29 days - 22 days - 15 days - 07 days - official weigh-in only a difference was observed in the last two weeks (week 03 and week 04) before the official weigh-in (see Table 2).

***** Table 2 near here *****

Regarding group comparisons, a main effect was verified in Anger during Official Weigh-in ($W=48.000$, $p=0.037$, $df=3$), where NWL group showed higher values than RWL group ($p=0.037$, $ES=0.17$). No other effects were observed when compared moments or groups ($p>0.05$ for all mood measures).

DISCUSSION

The aim of the present study was to examine changes in bodyweight and mood states among professional MMA fighters, examining fighters who used rapid weight loss strategies, comparing data against fighters that did not. This is the first study to examine the effects of rapid weight loss in mood states of MMA professional fighters to the author's knowledge. The intense nature of MMA competition and potential risks of injury coupled with the deleterious health implications associated with engaging in extreme body weight reductions suggest that this is an important area of investigation. Fighters use rapid weight loss strategies to gain a physical advantage over an opponent on the basis of an assumption that weight and strength can be regained following weigh-in (15, 17, 20). In the present study, the control of body weight was evaluated 30 days before the competition. Results are consistent with previous research showing similar amounts of rapid weight loss occurs, with ~7% of total body weight, in short periods of

10-20 days (12) until four weeks, with weight loss between ~16% and ~5% from total body weight (3, 35).

In terms of performance, it appears there were no significant differences and therefore engaging in rapid weight loss did not appear to harm nor help performance. Athletes had a large difference effect size in the reduction in body weight after 30 day of weight loss period, from the first data collection, to the competition. It should be noted that the present study did not pair opponents and therefore we do not know if one fighter rapidly lost weight and the other fighter did not. If both fighters engage in severe weight loss strategies it could affect performance via the mechanisms outlined previously but because there has to be a winner, it might be a false assumption that rapid weight loss had no effect on performance. It should be noted that some studies did not report significant changes of performance following usage of rapid weight loss strategies (2, 13, 24, 26). It has been suggested that a reduction of ~ 5% in first body mass does not present significant changes in performance, provided that the athlete has a few hours to feed and hydrate after weighing (3).

In terms of changes in mood, results show rapid weight loss associated with feeling more confused 30 days from competition than fighters who did not intend to use rapid weight making strategies. Although the result was significant, and effect size was moderate, this result hints at the possibility that engaging in rapid weight loss creates a sense of uncertainty. Further, the rapid weight loss group also greater Total Mood Disturbance at all assessment points with a moderate difference effect size, an affective profile associated with poor adaptation to training (18, 22).

Although previous research has found that changes in athletes' mood states relates to performance in competition (7, 8), our data do not point to a relationship between these aspects. The hypothesis that rapid weight loss can lead to emotional changes was not supported in the present study. We suggest that throughout the athletic career, the athlete accumulates experience, and these changes of weight, suggest both physical and emotional adaptations, making the athlete achieves a good emotional regulation even with a water deficit and nutritional deficit.

Sport psychologists should reflect supporting for athletes' rights and responsible practices to avoid dangerous methods of rapid weight loss through procedures that could put athletes' mental and physical health at risk. Preceding reports showed a high percentage of inappropriate methods of weight loss (10, 25). An epidemiological study demonstrated that 60% of combat athletes reported using a method of rapid weight loss through increased energy expenditure and ~50% of them use saunas, diuretics and plastic clothing, and only 26.1% received advice from a nutritionist (25). Based on the assumption that dangerous methods can alter mood states and put athlete's life at risk, the present study controlled this type of intervention during collect data.

Choma et al. (9) found that mood changes, as a function of body weight decrease, are not maintained after the athlete returns to normal weight. Thus, even though there is a decrease in weight, some changes in mood, after nutrient intake, the mood returns to optimal levels. The present study looked at correlations between amounts of weight loss and mood states in MMA fighters, results reveals important contributions however, because we looked at fighters who are adapted to rapid weight loss (35), these findings may not translate to other sports.

PRACTICAL APPLICATIONS

The results are relatively conclusive in highlighting that rapid weight loss induces mood alterations, although this may be associated with an increased probability of the athlete losing their competition (5), it does not affect the professional MMA fighters' performance. Thus, coaches, medics and athletes might make use of various tools and techniques to Rapid Weight Loss. Our results can be combined with recent findings in the same field: a) There is no evidence that this behavior is free of risks to health and performance, therefore athletes should be discouraged to reduce weight by any means leading to dehydration and starvation. Increasing the usual amount of exercise and adjusting diet in long-term appear to be the most appropriate procedures when performed throughout the competitive season (26). b) When considering the psychological aspects related to weight reduction, athletes consider acute weight loss as a mentally important part of the pre-competitive preparation (23,24). c) The individuals who are the most influential in teaching athletes strategies for weight loss are typically the coach, training partners or former athletes, educational programs should focus on providing them with full explanations of how to properly advise MMA fighters about weight management procedures (14). d) Global MMA weigh-in regulations should be addressed with immediate effect to ensure the mental health of competitors (19).

Future research should investigate the influence of weight loss and mood states (7, 8), together with environmental factors related to athletes' expectations inness (Judge et al., 2012), technical-tactical actions (28) and mental skills (38). Associated to mood states analysis, this psychological assessment of athletes will give the opportunity

to identify how an athlete cope with stress induced by weight loss and by a competition and various mental preparation strategies should be advised for performance enhancement (7).

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1 **Table 1.** Descriptive analysis of mood states in MMA fighters throughout different
 2 assessment points

Mood state/Time	No Rapid Weight Loss group			No Rapid Weight Loss group		
	μ	Q1	Q3	μ	Q1	Q3
Anger^B						
<i>Training</i>	1.0	0.0	3.0	2.0	1.0	4.5
<i>Official Weight-in</i>	6.0	1.0	7.0	0.0	0.0	2.0
<i>Pre-bout</i>	2.0	0.0	7.0	0.0	0.0	4.0
<i>Post-bout</i>	0.0	0.0	2.0	0.0	0.0	4.5
Confusion^Y						
<i>Training</i>	1.0	0.0	4.0	1.0	1.0	2.0
<i>Official Weight-in</i>	2.0	0.0	2.0	0.0	0.0	0.5
<i>Pre-bout</i>	0.0	0.0	0.0	0.0	0.0	0.0
<i>Post-bout</i>	0.0	0.0	0.0	0.0	0.0	3.5
Depression						
<i>Training</i>	0.0	0.0	1.0	0.0	0.0	0.5
<i>Official Weight-in</i>	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pre-bout</i>	0.0	0.0	0.0	0.0	0.0	0.0
<i>Post-bout</i>	0.0	0.0	0.0	0.0	0.0	0.5
Fadigue						
<i>Training</i>	3.0	0.0	4.0	2.0	0.5	4.5
<i>Official Weight-in</i>	4.0	0.0	5.0	2.0	0.0	3.0
<i>Pre-bout</i>	0.0	0.0	3.0	0.0	0.0	2.5
<i>Post-bout</i>	3.0	0.0	8.0	2.0	0.0	5.5
Tension						
<i>Training</i>	2.0	2.0	2.0	3.0	1.0	7.5
<i>Official Weight-in</i>	6.0	2.0	11.0	4.0	2.0	5.0
<i>Pre-bout</i>	2.0	0.0	2.0	3.0	1.5	4.0

<i>Post-bout</i>	3.0	0.0	5.0	0.0	0.0	3.5
Vigor						
<i>Training</i>	11.0	8.0	16.0	13.0	8.0	16.0
<i>Official Weight-in</i>	12.0	12.0	15.0	15.0	12.5	16.0
<i>Pre-bout</i>	15.0	15.0	16.0	16.0	14.5	16.0
<i>Post-bout</i>	14.0	13.0	16.0	13.0	9.5	15.0
Total Mood Disturbance						
<i>Training</i>	-10.0	-16.0	-7.0	-8.0	-11.0	-4.0
<i>Official Weight-in</i>	3.0	-9.0	9.0	9.0	5.0	10.0
<i>Pre-bout</i>	3.0	-4.0	12.0	11.0	2.0	14.0
<i>Post-bout</i>	-2.0	-3.0	16.0	3.0	-2.5	14.0

3 Note.: ^β = differences between No Rapid Weight Loss group and Rapid Weight Loss group; [‡] = different
4 from Weight Training moment; $p \leq 0.05$; Data expressed as Median (μ), first quartile (Q1) and third
5 quartile (Q3).

6 **Table 2.** Descriptive analysis of weight- in MMA fighters throughout different
7 moments.

Weight- in	No Rapid Weight		Rapid Weight Loss
	Loss	Sig	
<i>Week 01- 29 days</i>	77.6 (2.1)	<i>P=0.164</i>	73.1 (1.8)
<i>Week 02- 22 days</i>	76.8 (2.3)	<i>P=0.208</i>	70.5 (1.7)
<i>Week 03 - 15 days</i>	75.4 (2.6)	<i>P=0.054</i>	68.1 (1.5)
<i>Week 04 - 07 days</i>	74.3 (2.4)	<i>P=0.028</i>	65.5 (1.4)
<i>Official Weigh-in</i>	79.3 (2.3)	<i>P=0.006</i>	66.2 (2.4)

8 *p*≤0.05.

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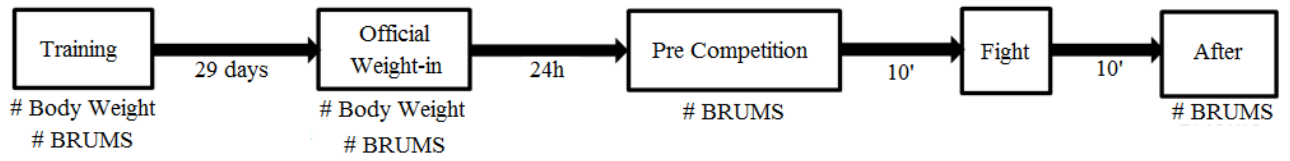
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26 **Figure 1.** Data collection design

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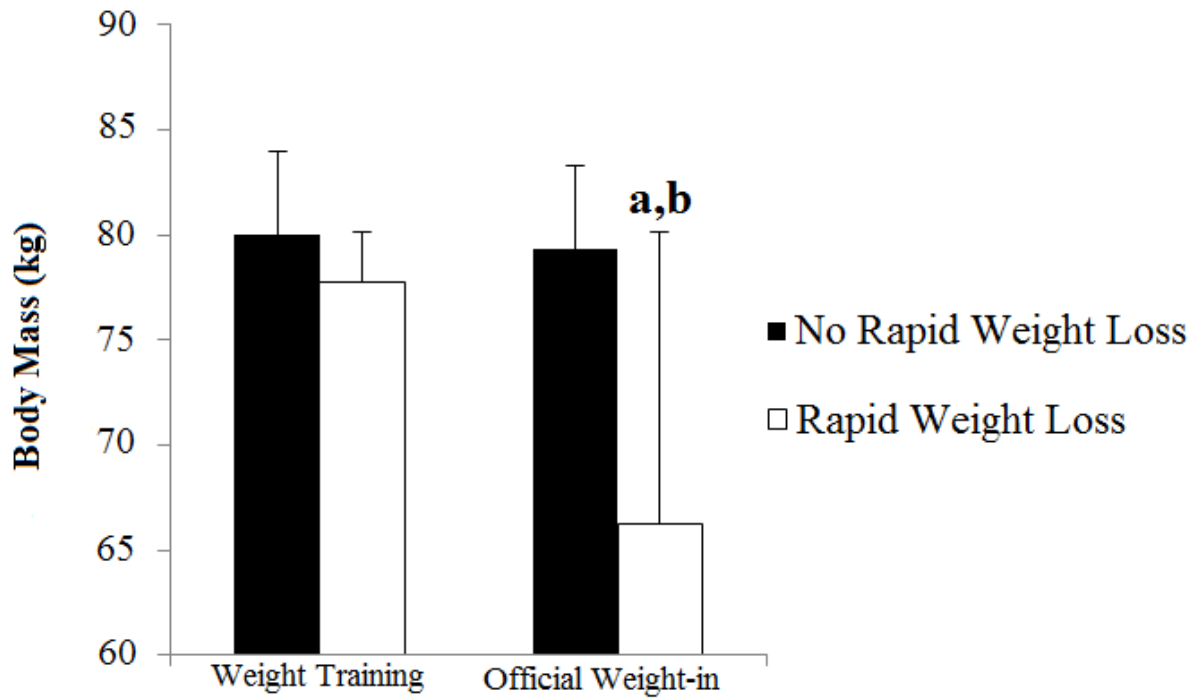
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55 **Figure 2.** Descriptive analysis of Body mass (kg) during Training and in Official
56 Weight-in moments of No Rapid Weight Loss group versus Rapid Weight Loss group.

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58 Note.: ^a different from the other group; ^b different from Weight Training moment, $p \leq 0.05$.

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